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EDITORIAL

TOBACCO

WE publish elsewhere in this number a short historical summary of local experiments in tobacco cultivation. When the experiments began in the year 1910 tobacco growing was already an established industry in the Jaffna Peninsula and in the coastal areas between Negombo and Chilaw and in Dumbara. Jaffna had developed an export trade with Travancore in chewing tobacco, while the remainder of the produce was used locally both for chewing and in the manufacture of cheroots.

The expansion of these markets kept pace with the growth in the volume of production till about the year 1910 when the demand began to slow down. The imported cigarette began to usurp the place of the cheroot while the younger generation of Ceylonese did not cultivate the chewing habit and Indian competition challenged the supremacy of the Jaffna variety in Travancore. These symptoms induced the Ceylon Agricultural Society to undertake experiments for the purpose of growing a tobacco which would find a place in the European market. A large number of tobacco varieties was tested, but the White Burley was the only type which gave any promise of success. A very favourable market for Ceylon White Burley was found and the area under this crop in the Jaffna Peninsula steadily expanded till it was reported from London that the Ceylon White Burley had lost its distinctive colour and had fallen off considerably in quality. There was no one in Ceylon competent to determine and remedy the causes of this decline. The 1934 crop was sold at an unremunerative price and the whole of the 1935 crop remains in the hands of the Sale Society; no White Burley was planted in 1936. More recent trials with types of cigarette tobacco have been inconclusive because

there is no one in Ceylon competent to analyse a buyer's report, to appraise correctly the causes of the failure to satisfy the market, and to adopt such selective and cultural methods as would make the produce acceptable to the buyer.

Meanwhile the contraction of the local and the Travancorean demand for the coarse chewing and cheroot tobaccos has proceeded with accelerated pace. The chewing habit has all but disappeared in Ceylon. The cigarette has largely replaced the cheroot, and the quota of the Travancorean market which the Government of that State has conceded to Ceylon finds a place in that market only at a price which is bound to cause the extinction of the Industry.

No useful purpose would be served by reviving the 25 year old experiments, initiated by the Ceylon Agricultural Society, for evolving a variety of tobacco for the European market. So far as fire-cured and air-cured tobacco for pipe smoking is concerned the British market is saturated with Empire tobaccos, and it is unlikely that there will be an expansion of this market. The problem of producing a satisfactory cigarette tobacco for a highly developed and very sensitive market is not an easy one to solve. The American article remains supreme in the Empire market in this class of tobacco. Southern Rhodesia and Nyasaland are the largest British producers. They have spared no effort and no expense to produce a variety that can compete with American tobacco. Southern Rhodesia still spends £25,000 annually on experiments alone. Yet these two countries together are unable to produce cigarette types suitable for more than a small fraction of the Empire requirements. Ceylon with its less favourable climate and less suitable soils cannot hope to join in the race for a long time to come.

There remains, however, the local market for cigarettes. An opportunity for capturing this market is afforded by the growth of a local cigarette manufacturing industry controlled by a powerful firm which has already done much in certain British dependencies in the encouragement of the production of cigarette types of tobacco for consumption in the respective countries of origin. But neither this Company nor any other competitor that comes into the field can do very much unless there is the expert tobacco grower to co-operate with them. That expert must be found abroad. If a really first-class tobacco expert is found and the co-operation of the manufacturing firms is secured, there is no reason why tobacco growing should not occupy a larger place in the economic life of the people of this country than it did in the past.

TOBACCO IN SOUTH INDIA*—I

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WITHIN recent years, tobacco has shown great possibilities of development in South India and it is now rapidly advancing to the position occupied by the major economic products of the country. It is a crop which, after its introduction into India by the Portuguese in the sixteenth century, has been intensively cultivated by the peasant and has gained widespread popularity in its uses in different forms. But its cultivation has been largely restricted to dark, heavy and strong flavoured types which are quite unsuited to Western tastes. Thus, most of the tobacco grown is consumed locally and the export trade is small in proportion to the area cultivated. Recently, however, efforts have been made to introduce new types and methods of growing and curing the crop to meet the changing fashion in the tobacco habit of the public for light, mild flavoured smoking tobacco and also to participate in the requirements of other countries, chiefly of the United Kingdom, in unmanufactured leaf. Large scale enterprises have now sprung up to promote an important internal and export trade in light tobaccos.

The cultivation of this crop to any appreciable extent is carried out in South India only in the districts where the rainfall is less than about 40 inches per annum. In the Madras Presidency which is the second largest tobacco producing province in India there are about 292,000 acres with an output of about 286 million pounds of leaf, the total area and production in India being about 1,350,000 acres and about 1,000 million pounds of leaf respectively. In Mysore State, the area is about 25,000 acres.

In South India, tobacco is grown for the following uses :—

(1) Smoking
(2) Chewing
(3) Snuff

*This article is based on a report prepared by the writer on his recent tour in South India.

The most extensively cultivated class in the Madras Presidency is smoking tobacco which is estimated to occupy about 221,500 acres while chewing tobacco is grown on about 67,500 acres and snuff tobacco is limited to about 3,000 acres. But in several of the districts where the dark, strong flavoured types of tobacco are grown there is no clear distinction between the tobacco cultivated under each class, for a crop specially grown for one purpose may be used in part for another. This is also so in most areas of Ceylon where tobacco is grown but it does not lead to the best development of a tobacco grown under each class since not only the varieties but also the methods of growing and curing the crop in each class—and in the case of smoking tobacco each type—differ considerably.

The present day market all over the world is preponderantly for smoking tobaccos and the future prospects of chewing and snuff tobacco both in India and Ceylon as elsewhere are not bright. In this article, attention is, therefore, only directed to the position of smoking tobaccos in South India.

TYPES OF TOBACCO

Tobacco may be separated into the following two categories based on the colour and strength of the leaf :—

(*a*) Light

(*b*) Dark

The light tobaccos are associated with mild flavour and comprise cigarettes (bright Virginia), pipe mixtures and beedies while the dark tobaccos which are of strong flavour are the cigars, cheroots as well as types of chewing and snuff tobaccos.

At the present time, light tobaccos are gaining favour amongst most except the poorest peasant classes who on account, perhaps, of their hard and vigorous out-door life, can find satisfaction only in the consumption either by the smoking or the chewing of dark, heavy and strong flavoured tobaccos. In the United Kingdom the consumption of cigarettes is increasing rapidly at the expense of all other types while in India cigarette smoking is steadily growing in popularity especially after the advent of cheap brands in the country. A large demand has arisen for light tobaccos for the cigarette and pipe trade from overseas countries, particularly the United Kingdom and for cheap grades from Japan.

For those who following the dictates of fashion demanded a light smoking tobacco but could not afford the luxury of the more expensive cigarette, the beedie or Indian cigarette has been made available. This type of tobacco was also popularised as a result of the Swadeshi Movement which advocated beedies in preference to cigarettes. The light tobacco industry has thus been developed and is making striking progress. As for the dark smoking tobaccos there has been little or no work carried out in regard to the improvement of the varieties grown and the methods of production of these in South India. They are, generally, still too dark, coarse and strong for export markets which are also limited. The internal trade is affected by the competition of light tobaccos and the absence of standardised brands of uniform quality. Much of the tobacco grown for cheroot purposes is rolled locally. Nevertheless, there are possibilities of development of these two types of tobaccos which need to be of a lighter brown colour, milder flavour and of better burning quality.

A. LIGHT TOBACCOS

(1) *Bright Virginia.*—The increasing demand for bright tobacco both in India for local manufacture of cigarettes and in the United Kingdom and Japan has led to vigorous efforts made to produce this type of tobacco in India. The standard brands of cigarettes manufactured in the United Kingdom are from American bright Virginian tobacco. Trials were made with different varieties of this type both in India as well as in certain other countries of the Empire and it is now being successfully grown though the tobacco is not of the same high quality as American Virginia. In the Madras Presidency, the tobacco has so far only proved successful in the Guntur district where the soil conditions are more suited than elsewhere for the cultivation of this type. Trials were begun about 15 years ago in the district by the India Leaf Tobacco Development Company, Calcutta, with varieties of Virginia tobacco and there are now about 40,000 acres under a single variety, *viz.*, Harrison's Special which has proved to be the best. The Company has established various depots in the district and assisted the cultivators by supplying seed, designing the flue barns necessary for curing the crop and purchasing the leaf on contract.

Flue-cured bright Virginia from the Guntur district is used in the manufacture in India of the standard brands of

cigarettes while sun-cured Virginia and country tobacco from the same district find a market as a blend in the numerous cheap brands now being manufactured by various small concerns. Increasing quantities of bright Virginian tobacco which must be flue-cured for the production of the necessary lemon yellow colour required in the cured leaf are being exported to the United Kingdom and the quality is considered to have improved greatly in recent years. Bright tobaccos are being increasingly used in the United Kingdom for pipe mixtures.

(2) *Sun-cured Virginian and Guntur Country Tobacco.*—Growers of Virginian tobacco sometimes subject their crop to sun-curing. This was the method adopted in the earlier years when Virginian tobacco was first introduced into the district. The leaves do not, however, develop the same bright yellow colour and flavour of flue-cured Virginia but they remain light in colour. Country tobacco when sun-cured has a light colour with a mild flavour. This is partly due to the fact that the tobaccos grown on the black clay soils of the district are unirrigated and do not, therefore, remain as thick and dark as the irrigated tobaccos grown elsewhere. There are about 80,000 acres under sun-cured country tobacco in the Guntur district, of which a large quantity is exported to the United Kingdom as a blend in the pipe trade and to Japan to meet the demand for cheap, light tobaccos.

(3) *White Burley.*—This type has been only grown to a limited extent in the Guntur district and during the 1934-35 season was cultivated on about 2,000 acres. The lighter shades were used for blending in cigarettes and the darker in pipe mixtures, twists and plugs. The White Burley market in the United Kingdom has dropped considerably as the demand at the present time is for Virginian cigarettes of bright colour. There is, however, a re-export trade to the Continent of Europe from the United Kingdom but the prices are too low. The market for this type of tobacco is so restricted that its cultivation is being discontinued. The only points in its favour are that being particularly suited to limestone soils it grows without difficulty on the black limestone soils of the Guntur district and its curing is simple.

(4) *Beedies.*—In the beedie, light country tobaccos of mild flavour from different sources are blended after being chopped up into small pieces and are then wrapped in a conical

form to a length of about 2 inches in the leaf of a tree named *Diospyros melanoxylon* which grows in the forests of Mysore, Hyderabad, Central Provinces, etc. Usually about 3–7 different varieties of tobacco are used being specially selected for a smooth, soft texture and bright colour. A large percentage of the tobacco in beedies is from Nipani, a village in the Bombay Presidency as the tobacco grown there is known to impart to the beedie a particular flavour. Other important varieties in blending are *Choora* and *Bindi* from Mysore. The middle portion of the Guntur Virginian leaf which is considered to be too thick for use in cigarette manufacture is taken for beedies.

Beedies are made very easily and are thus turned out all over South India in bazaars, etc.

B. DARK TOBACCOS

Cigars and Cheroots.—The cheroot which is distinguished from the cigar by being open at both ends instead of tapering at one end to a point and also being usually shorter in length is still the most popular form of smoking amongst the large peasant population of South India. The cigar, on the other hand, is regarded as a luxury and is mostly indulged in by the wealthier classes amongst the European residents in India.

Nearly all the cigars and also the cheroots of the highest quality have an imported wrapper leaf because the production of such requires great skill and care which is somewhat outside the scope and ability of the peasant cultivator. The other components of the cigar—the filler and binder—are of local leaf in the cheaper cigars but the better brands are made entirely of imported leaf such as Sumatra, Java, Manila, Havana and Borneo.

Cigar filler tobaccos are only used from certain areas, especially in a tract between Dindigul and Trichinopoly, while cheroot tobaccos are extensively cultivated in the Madura, Coimbatore, Trichinopoly, Salem, Kistna, Godaveri and Vizagapatam districts on a total area of about 105,000 acres. There is no distinction between the cheroot and cigar filler tobaccos in the varieties or methods of cultivation and curing except that cigar manufacturers select certain fields known for the superiority of the tobacco produced from them and purchase their requirements of leaf from such fields only. South Indian cigars were popularly known as Dindigul cigars from the centre

where they were first manufactured but they are also produced in Trichinopoly and Madras. The export trade is small owing to the high import duties on cigars in other countries. The export of unmanufactured cigar leaf tobacco to the United Kingdom has also not made much progress because the consumption of cigars there is steadily declining on account of high prices. The chief Empire source of supply is British North Borneo and Indian filler has little demand. Even in India, the cigar trade is steadily decreasing owing to the high prices of good quality, mild flavoured cigars.

The common cheroots are dark and of strong flavour, some being of greater pungency than others according to the district in which the tobacco is grown. The burning quality is usually poor and the production is not standardised. In general, the cheroot tobaccos from the Madura, Trichinopoly, Coimbatore and Salem districts are less pungent and of better burning quality. The well-known Trichinopoly cheroots are manufactured from selected tobaccos grown in these districts.

There are still many who have been accustomed to the flavour and aroma of a good cheroot while there are others who regard the cigar as too large and expensive but who object to an ordinary cheroot on account of its pungency and dark colour. Improvement of the dark smoking types should therefore be directed along two lines :

(1) A mild flavoured, light brown leaf suitable for manufacture of mild cheroots and as fillers for cigars.

(2) A strong flavoured, dark tobacco for manufacture of strong cheroots.

It is essential that the burning quality and texture of the leaf of each should be improved. It should then be possible to obtain a better export market for cigar filler leaf even though it would only be to a limited extent. Manufacturers in the United Kingdom are making efforts to popularise midget cigars and some progress has been reported during the last few years. This offers hopes in the improvement of the cigar leaf exports of Empire countries helped by tariff preferences.

(*To be continued*)

THE HOT FERMENTATION PROCESS OF COMPOSTING UNDER TROPICAL AND SUB-TROPICAL CONDITIONS

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IN recent years much valuable work has been done, especially in India, [1-5] on the conversion of various forms of municipal waste, including night-soil, into organic manures. The methods so far employed are largely aerobic in character and it is generally recognised that they involve much loss of nitrogen. It is also known that when large quantities of night-soil are applied (either as a single dose or in instalments) the initial rise in temperature is not maintained, so that pathogenic and putrefactive organisms and weed seeds continue to flourish, the smell becomes highly offensive and the compost heap becomes a breeding place of flies.

With a view to overcoming the above defects and to reducing the loss of nitrogen, an extensive series of trials were carried out, both in the laboratory and on the field, applying the principles of the hot fermentation (Edelmist) process originally developed by Krantz [6]. The process is quite simple and easy to manipulate, and needs practically no attention during the process of composting. Besides rendering the product hygienically sound which is so essential from the municipal point of view, the method gives a good yield of manure with a pretty high nitrogen content.

The procedure as adopted by us consisted in allowing the materials to undergo a brief initial, aerobic fermentation when the temperature rose to over 73°C; they were then packed into cisterns made of brick and clay which were completely closed. After three months the cisterns were opened and the contents dried and screened in the usual way.

It may be mentioned that there was no offensive smell at any time during the fermentation. Fly-breeding was also absent. The finished product crumpled to fine powder and

had a pleasant earthy odour. The recovery of nitrogen was almost quantitative when the C–N ratio was fairly wide, but at the narrower ranges (especially at the ratio, 10 : 1) loss of nitrogen could not be avoided. This was largely traceable to the unexpectedly heavy rains which percolated through the walls of the cisterns and caused a part of the soluble salts to diffuse out. It may be observed, however, that the nitrogen contents of the finished products were much higher than those obtained by other methods.

Table I contains some of the more interesting results obtained by composting town refuse on the field in overground chambers. The C : N ratios were adjusted to 30 : 1 and 10 : 1 by adding ammonium sulphate, sodium nitrate, calcium cyanamide and night-soil as sources of available nitrogen.

Further work is in progress with a view to (*a*) designing a cheap type of underground pit (lined with concrete or other waterproof material) so as not to permit of seepage ; (*b*) determining the optimum initial moisture content and time of aerobic fermentation, and (*c*) standardising the conditions for the drying and storage of the finished product.

The author is greatly indebted to Professor V. Subrahamanyan for offering the facilities of the Biochemistry Department, and his keen interest in the investigation.

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TABLE I

Form of nitrogen added to refuse	C–N ratio at the commencement											
	30 : 1				20 : 1				10 : 1			
	Dry matter recorded lb.	Total Nitrogen before composting Lb. Oz.	Total Nitrogen after composting Lb. Oz.	% Nitrogen in the finished product	Dry matter recorded lb.	Total Nitrogen before composting Lb. Oz.	Total Nitrogen after composting Lb. Oz.	% Nitrogen in the finished product	Dry matter recorded lb.	Total Nitrogen before composting Lb. Oz.	Total Nitrogen after composting Lb. Oz.	% Nitrogen in the finished product
Ammonium sulphate	216	3 12	3 13	1·79	209	5 12	5 3	2·49	205	8 12	7 8	3·62
Sodium nitrate ..	216	3 12	3 13	1·82	237	5 12	4 14	2·13	240	8 12	6 3	2·74
Calcium cyanamide ..	207	3 12	2 9	1·19	228	5 12	5 0	2·06	224	8 12	6 0	2·45
Night-soil ..	224	4 9	4 8	1·47	—	—	—	—	—	—	—	—

Each cistern contained originally 250 lb. of refuse

THE IMPORTATION OF CITRUS FRUIT AND PLANTING MATERIAL INTO CEYLON IN 1935

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I. CITRUS FRUIT

THE quantity of citrus fruit which came into the Island in 1935 was 30 per cent. higher than that in the previous year and a little over double that in 1933. The number of cases of oranges, grapefruit and lemons imported was 6,694 cases in 1933, 10,529 cases in 1934 and 13,581 cases in 1935. The excess of the figure for 1935 over that for 1934 was made up of 1,658 cases from Palestine in the first quarter of the year, 704 cases from all countries in the second quarter, 1,137 cases from South Africa and Rhodesia in the third quarter and 865 cases from Cyprus in the last quarter.

The figures for the respective quarters during the past three years in comparison with those of 1933 taken as 100 are :

	1933 *Cases*	1934 *Cases*	1935 *Cases*
1st quarter	100	94	195
2nd quarter	100	154	221
3rd quarter	100	284	318
4th quarter	100	131	175

The figures for the last quarters of 1933 and 1934 exclude 314 and 1,158 bags respectively of limes which were imported from India to meet the shortage of this commodity in the Island.

The imports in each quarter of the past two years from the several exporting countries were as follows :

Period	*Country*	1934 *Cases*	1935 *Cases*
First quarter	Palestine ..	1,632	3,290
	Mediterranean ..	360	740
Second quarter	Palestine ..	690	880
	Australia ..	463	614
	California ..	265	351
	Mediterranean ..	117	310
	South Africa ..	114	225

Period	*Country*	1934 *Cases*	1935 *Cases*
Third quarter	California ..	539	817
	South Africa ..	954	2,091
Fourth quarter	Palestine ..	918	1,222
	Mediterranean ..	179	1,044

The countries from which citrus fruit arrives in Ceylon all show a steady increase in the quantity of their exports in the past two years, with the exception of Australia in 1935. The following table shows the volume of our trade with these countries :—

	1933 *Cases*	1934 *Cases*	1935 *Cases*
Palestine ..	3,136 = 100	3,240 = 103	5,392 = 171
South Africa	434 = 100	1,491 = 343	2,427 = 559
Mediterranean ..	433 = 100	656 = 148	2,094 = 484
California ..	1,026 = 100	1,648 = 160	1,839 = 179
Australia ..	1,200 = 100	2,259 = 188	1,810 = 150

Palestine.—The increase over the imports in 1934 amounted to 2,152 cases=66 per cent. Shipments totalling 4,170 cases arrived in the period January-April and 1,222 cases in the months of November and December. The highest imports in a single month occurred in February and amounted to 1,345 cases.

South Africa.—The increase over 1934 was 936 cases=62 per cent. The season of imports lasted five months from June to October, and the greatest quantity in one month totalled 1,013 cases in July.

Mediterranean.—Imports from this region are drawn entirely from Cyprus. The total for the year 1935 was phenomenal in comparison with those in past years. The annual mean for 7 years is 488 cases ; in 1934 the total was 656 cases and in 1935 amounted to 2,094 cases. It was somewhat exceptional that shipments arrived for a period of 9 months in 1935. From January to June 1,050 cases were received and from October to December 1,044 cases. In December alone the imports totalled 869 cases.

California.—The increase in 1935 was only 11 per cent. over the figure for 1934. Trade with this country declined badly with the steadily rising imports from Palestine, but an improvement has taken place within the past two years. Shipments arrive throughout the year but mainly in the latter half. In 1935 only 395 cases were received in the first half of the year

against 1,444 cases in the second half. In comparison with other countries the imports are small and the limited quantity of Californian citrus first imported is probably intended for customers who show a preference for this quality of fruit which is retailed at a higher price.

Australia.—Though imports in 1935 were 50 per cent. higher than those in 1933, the total was 20 per cent. less than the figure for 1934. The season of imports lasted for a period of eight months from May to December but the bulk of the shipments, amounting to 1,445 cases, arrived during the three months June to August.

The number of cases of citrus fruit imported, totalling 13,557 cases, was made up of the following varieties :—

Oranges ..	..	11,556 cases	= 85 per cent.
Grapefruit ..	..	1,715 ,,	= 13 per cent.
Lemons ..	..	286 ,,	= 2 per cent.

The distribution of oranges throughout the year was as follows :

34 per cent. = 3,978 cases in the three months January to March equivalent to 11·3 per cent. a month ;
11·6 per cent. = 1,346 cases in July ;
15 per cent. = 1,751 cases in December

The off-months were May, October and November with an average of 350 cases = 3 per cent. per mensem.

2. PLANTING MATERIAL

The planting material which comes into the Island from abroad consists mainly of living plants of great variety and a fair proportion of bulbs and tubers. Consignments comprise a very large number of small lots of garden plants brought over by passengers, but of late quite an appreciable quantity of plants, both orchard and ornamental, have been imported for commercial purposes. Single consignments of the latter class have run up as high as 1,000 fruit trees and 10,000 bulbs. In the year under review 667 consignments comprising 981 packages were imported, of these 48 per cent. were small lots brought over by passengers and received at the Fumigatorium from the Baggage Office of the Colombo Customs, 47 per cent. sent through the post and 5 per cent. imported through the Customs Warehouse. These figures in no way indicate the actual number of plants that have come into the country, in as much as a single package received through the post may have consisted of a

dozen or more plants or a case from the warehouse of a hundred or more. In the case of bulbs such as gladioli, a packet may contain 200 bulbs. A close study has been made of the quantities, varieties and sources of planting material coming into the Island and the information which is now presented may prove of some interest.

The total number of packages imported in 1935 consisted of:

	Packages
Bulbs and tubers	232 = 24 per cent.
Orchids	200 = 20 per cent.
Fruit trees	189 = 19 per cent.
Rose plants	70 = 7 per cent.
Other plants	290 = 29 per cent.

Bulbs consisted mainly of Dutch gladioli imported direct from Holland as well as to a small extent from England. Orchids generally came in small lots of a six to twelve plants each, but this year say a few large consignments. Fruit trees consisted chiefly of citrus grafts from Australia, an increasing number of mango grafts from India and a small percentage of temperate region fruits. Seventy consignments of rose plants, the majority of which consisted of half to a dozen plants each, together with the large lots found quite an appreciable total of nearly 1,500 plants. Other plants is a term for a very miscellaneous lot of plants in pots, cuttings, roots and seeds.

As would be expected planting material comes in throughout the year. In 1935, April, August and September were slack months. During the rest of the year the quantities which came in were as follows :

	Packages	
January	84	
February	75	
March	68	227 = 23 per cent.
May	71	
June	81	
July	83	235 = 24 per cent.
October	99	
November	121	
December	134	354 = 36 per cent.

The seasons for the different varieties of plants were as follows :

Bulbs and tubers.—38 per cent. arrived in January to March and 30 per cent. in October to December ;

Orchids.—Consignments were about even throughout the year, though higher in November and December. The largest quantity judged by the number of packages amounting to 30 per cent. arrived in the period May to July ;

Fruit Trees.—35 per cent. were received between May and July and 47 per cent. between September and December of which nearly half came in the last month ;

Rose plants.—50 per cent. were imported in the months of November and December ;

Other plants.—A fair quantity came in January and a third of the total in the last quarter of the year.

Sources of plants.—Based on the number of packages imported, India heads the list of countries with 37 per cent. followed by the United Kingdom with 24 per cent. and Australia with 17 per cent. As pointed out earlier this is no criterion of the actual number of plants. By far the greatest quantity was imported from Australia. Since some of the consignments consisted of a large number of plants compared with previous years the quantity from the United Kingdom has shown an appreciable increase. The Far East (comprising the Malay States, Java, the Philippine Islands and Japan) and other countries were each responsible for 11 per cent. of the total consignments.

The seasons of imports from the several sources were as follows :

United Kingdom.—The bulk amounting to 54 per cent. arrived in the last quarter of the year while the first quarter claimed 27 per cent.;

India.—Plants came in throughout the year though mostly at the end, 31 per cent. being received in the period October to December ;

Australia.—The heaviest months were June, July and October and 73 per cent. of the consignments arrived within the period of five months June to October ;

Far East.—Small lots were received throughout the year and consisted chiefly of miscellaneous plants ;

Other Countries.—Nearly half of the consignments were received in the first quarter of the year.

A few of the largest consignments received in 1935 were 5 cases of gladiolus bulbs, 10 cases of orchids and 21 cases of fruit plants and roses.

DENDROBIUM SUPERBIENS, RCHB. F.

NOTES ON ORCHIDS CULTIVATED IN CEYLON

DENDROBIUM SUPERBIENS, RCHB. F.

EDWARD PERERA

CURATOR, HENERATGODA BOTANIC GARDENS, GAMPAHA

THIS magnificent species is a native of tropical Australia, and is undoubtedly one of the most charming of all the Dendrobes.

It is a most profuse bloomer and has the peculiarity of blooming from the old stems at the same time as from the new ones, and frequently repeats this freak of nature for several years in succession.

In addition to this it flowers in a very young state, when the stems are scarcely 6 inches high. These stems when fully grown are from 2 to 3 feet high, and about 3 inches in circumference, furnished with thick, oblong acute leaves. The flowers are produced from fifteen to twenty-five at a time in long racemes, the sepals being dark purple, beautifully reticulated, and having a whitish border, the petals of a beautiful warm purple, longer than the sepals, and the lip crimson-purple, short, with incurved side lobes. The flowers last three months in perfect condition.

Culture.—This an other allied species, which have jointed, bamboo-like pseudo-stems are easily propagated by removing the ripe pseudo-stems from an old plant, cutting them into lengths of 6 inches or so, and fastening them on to pans or baskets of moist sphagnum moss. Under this treatment the pieces soon form shoots and these when rooted may be removed and planted separately in a compost of porous brick, charcoal and bone, the ordinary compost used for Dendrobiums. It requires very moist tropical treatment when growing. Owing to free and vigorous root action of this plant, a fairly large sized pot, preferably made of teak, should be provided, if the best results are to be obtained. The plant likes plenty of sunshine after it is well established.

DEPARTMENTAL NOTES

HISTORICAL SUMMARY OF TOBACCO EXPERIMENTS IN CEYLON

EXPERIMENTS with tobacco in the Island have been conducted with a view to the production of a commodity suited to the European market. Systematic attempts in this direction, under the auspices of Government, date from the Mahaillupalama trials conducted by the Ceylon Agricultural Society, which was the forerunner of the Department, in 1910.

I. The Ceylon Agricultural Society decided to experiment for one year in the production of a leaf for the European market. Twenty acres were to be opened under Sumatra and Java varieties at Mahaillupalama. As it was considered inexpedient to engage the services of an expert, which would have entailed heavy expenditure, supervision of the experiment was entrusted to Mr. E. Cowan while the work was to be carried out by the Manager of the Mahaillupalama Station.

In 1910 about 25 acres were planted with Sumatra and Java varieties ; in 1911 only Sumatra tobacco was planted ; the Society then dropped the scheme and work was continued on behalf of the Botanic Gardens Department.

In 1911 Mr. J. Van Leenhoff, Tobacco Expert to the Transvaal Government, visited Ceylon on a private engagement. His services were thereupon requisitioned by the Ceylon Agricultural Society to report on the Mahaillupalama experiment and by Government to report on the tobacco industry in general.

The opinion of Mr. Van Leenhoff regarding the Mahaillupalama experiment was that it was badly carried out and work should be stopped at once, and an expert in tobacco should conduct the work in future.

Mr. Van Leenhoff's views regarding tobacco in general, which formed the basis of future work, were as follows :

" At present the area devoted to chewing tobacco largely exceeds that occupied by cigar tobacco, a state of affairs which

may be reversed in view of the fact that the only export market for the chewing tobacco, South India, may cease to be available.

The aim should be to abandon a large part of those fields where tobacco is grown at present and to start tobacco culture on land in localities where there are possibilities for cigar and cigarette tobacco."

His final conclusion was that taking all the facts into consideration, it seemed worth while to continue experimental work in Ceylon, since the prospects of growing and curing a tobacco suitable for export to Europe were not unpromising. It was essential that such experimental work should be prolonged, and that it should be conducted under expert supervision, both with cigar tobacco and tobacco of the Virginian type.

(The Department of Agriculture was established in 1912).

II. The first tobacco expert, Mr. B. F. Scherffius, arrived in Ceylon in May, 1914.

Land for a trial ground was secured at Tinnevelly, Jaffna.

The object of the work was to ascertain whether good class leaf cannot be produced for the European market.

Several varieties comprising pipe, chewing, cigarette, wrapper and filler tobaccos were planted, of which a few kinds were selected for experimental work.

In 1917 after 3 years' work Mr. Scherffius came to the following conclusions :

(1) flue-cured tobacco could not be produced under the soil and climatic conditions of Jaffna ;

(2) the production of a high grade tobacco of the cigar type suitable for European markets was unlikely owing to the bad burning qualities caused by excess of chlorine ;

(3) the results by the trials with air-cured White Burley tobaccos for pipe and cigarettes were encouraging and worthy of being continued on a more extensive scale.

Mr. Scherffius left on the termination of his agreement in 1917.

In 1916 trials were also conducted on the Anuradhapura Experiment Station ; three varieties were grown ; growth was as good as in Jaffna ; the crop was air-cured and sent to Jaffna for final treatment.

The object of work in Jaffna thence forward was to popularise the cultivation of White Burley.

During the next few years White Burley was cultivated on the Jaffna station as a commercial crop and the cured leaf was sent to the Crown Agents in London for disposal. The 1919 crop realised 1s. 9d. a lb. and the reports on quality were encouraging. In 1920 propaganda work was carried out to popularise the cultivation of this crop which the Department undertook to purchase in the form of green plants from growers at the rate of 8 cents to 20 cents per plant. In 1923 there were 27 growers of White Burley and the crop realised 1s. 6d. in London. In 1934 Government inaugurated a Purchase Scheme worked by the Agricultural Department whereby cultivators received part payment for their produce, the balance being paid on completion of sale in London. The crops which were cured by growers were brought to the Jaffna Station for grading and baling before dispatch to the Crown Agents. This scheme operated till 1932 when the Jaffna White Burley Tobacco Sale Society was formed. The number of growers has varied each year. During the period 1925 to 1930 the number respectively was 268, 219, 166, 250, 270 and 243. Since then there has been a falling off and in 1934 the number was 158.

Prices have fluctuated between 1s. 1½d. and 1s. 9d. a lb. and since 1929 a drop has taken place.

The total production of White Burley tobacco in Jaffna rose to 28,386 lb. in 1928. In the three years 1932-1934 the figures were 11,140 lb., 15,175 lb. and 22,708 lb. In his report for 1932 the Director of Agriculture drew attention to the necessity of standardising Ceylon produced White Burley as difficulty was being experienced in selling the tobacco in the London markets at prices which prevailed in previous years. Since the formation of the Co-operative Sale Society, reports have been received of the deterioration of quality of Ceylon grown White Burley. The price secured for the 1934 crop was 8d. to 1s. 3d. a lb. and the 1935 crop still lies in the hands of the Co-operative Sale Society.

III. In November, 1918, Mr. W. B. Wilson arrived and was appointed as Tobacco Expert to take charge of the work at Jaffna and also establish an experiment at Teldeniya.

Foundation trials for more intensive experiments, variety tests and general observations were laid down at Teldeniya.

Eleven varieties were transplanted in April, 1919.

The crops were harvested and had to be brought over to the Experiment Station, Peradeniya, for fermenting and grading as Mr. Wilson, whose services were engaged in the first instance for one year, resigned in November, 1919.

The work was then carried on by the Manager, Experiment Station, Peradeniya, and Acting Divisional Agricultural Officer, Central, whose report for 1920 stated that 6 acres were planted out. In the report for 1921 it was stated that there was no market for the 1919-20 crops sent to England and India. Therefore the manufacture of cigars was undertaken with the crop in hand. The Teldeniya site was given up and work transferred to the newly opened agricultural station at Nalanda where, after a while, tobacco ceased to be grown.

IV. In 1923, the Director of Agriculture drew attention to the visit of representatives of the British American and Imperial Tobacco Companies and of the Indian Leaf Tobacco Development Company, all of whom confirmed the view that the only types of Ceylon tobacco suitable for the European markets were the Burley types and recommended that the trials already made with these types in the Jaffna district should be extended to others. The recommendations more precisely were: (1) White Burley in Jaffna and possibly elsewhere should be continued; (2) attempts should be made to grow a thin cigar wrapper leaf in the Dumbara area; (3) experiments should be made with flue-curing.

V. In 1931 White Burley, was tried in Tamankaduwa and on the agricultural stations at Vavuniya, Anuradhapura and Ganewatte. At Ganewatte experiments were inaugurated to determine the best means of curing for which purpose a small flue-curing shed was constructed.

Since then systematic work has been conducted on both Ganewatte and Wariyapola stations.

In 1933, a suitable type, *viz.*, Harrison's Special for cigarettes was selected and grown at Wariyapola and Ganewatte, and two flue-curing barns erected.

VI. In 1934, The Ceylon Tobacco Co., Ltd., arranged for a visit by Mr. Cooper, an American expert, who spent 3 weeks at Ganewatte and Wariyapola and gave a thorough demonstration in the handling of the tobacco crop, besides conducting training classes which a number of Agricultural Instructors attended.

Four flue-curing barns were constructed, 2 at Ganewatte, 1 at Wariyapola and 1 at Maho.

CHEMICAL NOTES (14)

THE CURING OF CASHEW NUTS FOR EXPORT

A. W. R. JOACHIM, Ph.D.,
AGRICULTURAL CHEMIST

ENQUIRIES have been received by the Department from time to time, on the method of curing cashew nuts for export. In S. India the cashew nut industry is well organised and a fairly considerable trade in the commodity has already been established with the United States of America and Europe. The methods adopted in that country have been studied on a laboratory scale in the Chemical Division with a view to determining whether they could be modified or improved upon in any way. The results obtained are briefly referred to in this note which deals mainly with the curing processes as practised in S. India. These are as follows :

(1) *Removal of the pericarp or shell.* (a) *Roasting.*—The cashew nut has a very tough pericarp or shell which contains a caustic oil and makes the shelling of the nut a troublesome process. Roasting of the nuts is adopted in India to render them brittle and less caustic to the skin when broken. The oil is thereby removed, even partially. The roasting is done in open iron pans over a small circular earthenware furnace. Small quantities of nuts are treated at a time and the period of roasting is about a minute. The rinds of the previously shelled nuts serve as fuel. Great care is taken that the nuts are not over-roasted or the kernels would be browned and thus rendered unsaleable abroad. Excessive roasting is prevented by throwing water on to the pans to extinguish the fumes. Several of these furnaces are operated together and the smells emanating are so acrid and unpleasant that the factories have to be situated far away from the residential areas.

In order to ascertain whether the method of roasting in the open could be replaced by heating in an oven, trials were made in the Chemical Laboratory with the heating of the nuts

in an electric oven at different temperatures and for varying times. It was found that temperatures below 100° C. were insufficient as the nuts continue to be tough and leathery. Heating at 120° C. for half an hour makes the shells somewhat brittle, but some of the kernels are partly discoloured. A temperature of about 115° C. would perhaps be more suitable from the standpoint of discolouration of the kernels. Tests with a roasting machine in S. India showed that it had the same defect of browning a higher percentage of kernels than would be the case in the open pan roasting method. Heating at high temperatures of short duration is preferable to heating at lower temperatures of longer duration, as the kernels are not then discoloured. If the furnaces could be operated in one shed so designed as to cause the suffocating gases to be drawn up a chimney by suction, the nuisance might be avoided to some extent. But the cost of installation of such an arrangement would be fairly high and may considerably increase the cost of production.

(*b*) *Shelling.*—The roasted nuts are next shelled. This is a very skilled operation and in S. India is mostly done by women and boys with a sort of wooden mallet. The greatest care is required in shelling if kernel breakages are to be reduced to the very minimum. The kernels are removed from the shell with a wire prong.

(*c*) *Inner Coat Removal.*—It is essential for export purposes to remove the pink to reddish brown inner coat. In India this is done by spreading the nuts on wire gauze trays in hot air rooms under controlled temperatures. Heating at a temperature of about 120° F. for three hours is generally found to be best under Indian conditions. As this optimum temperature will vary with the climatic conditions and the nature of the nuts, it is not surprising to note that under local conditions a temperature of about 155° F. has been found more suitable. At higher temperatures the kernels become too brittle. The drying of the kernels, besides removing the inner coat, removes any excess moisture in them and thus prevents the tendency to mouldiness in storage. The use of wire gauze trays tends towards a discolouration of the kernels at points of contact with the metal. Some suitable textile fabric may be substituted if necessary. The seed coat is removed soon after the kernels are taken out of the oven. This operation is also done

by hand. Delay in peeling renders the process more difficult. After peeling the kernels are spread on the floors indoors, when they absorb some moisture and become less brittle. An actual determination showed a gain in weight of about 1 per cent. moisture in two hours.

(*d*) *Grading.*—Cashew nuts are graded into : (1) *wholes* or completed kernels ; (2) *halves* consisting of one cotyledon only; (3) *brokens*, the broken kernels ; (4) *rejects* or *spoilts*. Only grades (1) and (2) are exported, but the latter fetch much lower prices than the wholes. The brokens are sold locally and the rejects are used as poultry food together with the seed coats.

(*e*) *Packing.*—In India the well-dried, graded kernels are packed in 25-lb. tins. The nuts were until recently filled into the tins which were then charged with carbon dioxide gas and sealed. This practice has now been given up, as it was regarded as objectionable by importers. The filled tins are instead vacuumised through a small hole in the lid, which is then hermetically sealed. Experiments carried out in the Chemical Laboratory showed that cashew nuts were well preserved in vacuum or in carbon dioxide for as long a period as two years. Further, clean, well-dried nuts when well filled in hermetically sealed containers were found to keep satisfactorily for a period of over a year. The risks of damage in storage are however too great to advise the adoption of this practice commercially.

BY-PRODUCTS OF CASHEW

There are a number of by-products of cashew which should find some use locally. These are the rind oil, the seed coat and rejected kernels, the juice of the pedicel or soft fruit and the gum.

The rind oil when required, is obtained by heating the nuts in inverted earthern pots and collecting the oil that drains. As so obtained the oil is a dark, viscid liquid with a characteristic smell and caustic action on the skin. Its chief constituents are anarcadic acid, gallic acid and cardol. Only 12-15 per cent. of oil is obtained, though the rind itself contains about 35 per cent. of the by-product. Experiments done locally show that if rind oil is the primary consideration, it could be extracted by placing the nuts in a funnel-shaped container and heating the latter in an oven at a temperature of 120° C. or higher for a period of three or four hours. Pricking the nuts facilitates the

removal of the oil. The kernels, though somewhat browned, may find a sale locally. The oil can also be prepared from the shells obtained by cutting the thoroughly-dried nuts, as is occasionally the practice locally. The oil is used as a wood-paint, for treating fishing nets, etc., and when of good quality has found use in the manufacture of bakelite. The demand for the oil abroad is however small now and its present price in India is so low that it would not be profitable to prepare the oil at the expense of the kernel. It should be possible to obtain the oil by heating the nuts under reduced pressure, but the outlay on plant will probably render the process uneconomic. A very good quality oil has been obtained by extraction of the shells with solvents, but the cost will be prohibitive on a commercial scale.

The thin, pinkish-coloured testa or seed coats together with the broken kernel tips form a good poultry food. Analysis of a sample in this laboratory gave the following percentage results: water 8·1, proteins 7·6, fat 12·3, carbohydrates 59·2, fibre 11·0, ash 1·8. Its nutritive value is therefore high.

A gum obtained from incisions in the tree is reported to be insect-proof, due probably to traces of cardol. It could therefore be used for book-binding.

The pedicel or soft part of the fruit is used in the West Indies, Goa and elsewhere for the preparation of a spirit by the fermentation of the juice extracted from it. The juice contains about 8-12 per cent. of reducing sugars and has anti-scorbutic properties. The question of the manufacture of an alcoholic drink is however one which will be governed by Excise Regulations.

I am indebted to articles in 'Industry', the Madras and Mysore Department of Agriculture Journals, and to a report by Mr. W. R. C. Paul for information on the subject. Also to my Assistant, Mr. D. E. V. Koch, for carrying out the trials referred to.

PRUNING COFFEE TREES*

BEFORE describing the system of pruning which has been practised for three years running on the coffee plots at the Experimental Station of this Centre (a system which has given very satisfactory results, and which we therefore wish were understood and practised in this country), it is convenient, for the sake of clarity, to give a few lines to describing the development of the coffee tree and to consider the principles which are to be followed in the practice of pruning.

The coffee tree may be considered as consisting of two parts; a subterranean one which bears the organs of absorption known as roots, and a second, bearing those organs whose main function is the manufacture of the food supplies of the plant, which is called the stem.

Pruning is practised on the stem, and we are therefore concerned with its development.

The stem of the coffee tree grows vertically, becoming thinner and thinner until it terminates in a bud which is found at the junction of two opposite leaves and is protected by two membranous structures called stipules, which are formed at the base of the leaf stalks. The stipules protect the bud by means of their covering of waxy substance. The development of the terminal bud results in the indefinite prolongation of the stem, unless it is for any reason arrested.

As the bud develops, the stipules separate, and two small leaves appear, of a yellow-bronze colour, which later become green. These two small leaves are attached to a node of the shoot. The internode below this point increases in length and this lengthening is continued above the leaves.

Accompanying the terminal bud and covered by the same pair of stipules are two lateral buds, which give rise to the primary branches, commonly known as *bandolas*. The primary always grows from the angle of a leaf with the main stem, and its growth depends on the development of the terminal bud. In its earliest stage of development, the primary makes an angle of some 15° to 20° with the main stem, but, as it grows, the angle becomes wider and wider, until it lies in a nearly horizontal position. The first lateral buds, those which are formed in the axils of perhaps the first five pairs of leaves of the young coffee plant, do not develop unless the terminal bud has been destroyed below the fifth node, in which case they always take a vertical position and function as secondary shoots which will later produce secondary branches. Since in this case the shoots have sprung from the axils of the

*By B. R. Iglesias from *Revista del Instituo de Defensa del Cafe de Costa Rica*, Vol. 1, No. 4 (1935)

leaves, they form at the point of junction an acute angle, which makes them easily distinguishable from secondary shoots formed by the development of adventitious buds.

The primary branch has at its tip a terminal bud, together with two tiny lateral buds which may or may not develop.

The terminal bud is the one which increases the length of the branch; but if for any reason this bud is destroyed, then the lateral buds come into play, forming secondary branches or *palmillas*, which, in their turn, should the terminal bud be destroyed, may form tertiary branches.

The ramification of the primary branch may occur without the elimination of the terminal bud if the plant encounters particularly favourable conditions for its vegetative growth. In some cases it has been observed that adverse conditions may produce the same effect.

If the terminal bud of the main stem be destroyed at about the fifth node, above a pair of already formed primary branches or if for any other reason the flow of sap in the upward direction is interrupted, secondary shoots appear, growing from adventitious buds which are formed below the junction of the secondary branches with the stem. These new shoots are generally formed in pairs at the last node of the stem. If the last two primary branches are cut away, these shoots develop rapidly, otherwise the sap goes on nourishing the primary branches and consequently the appearance of the shoots is retarded.

Under certain circumstances—for instance, after a heavy crop—if circumstances have not been sufficiently favourable to allow of the development of new wood at the same time as the production of fruit, the main stem, as well as the secondaries if there are such, will become covered for nearly the whole of their length with adventitious shoots or *hijos* (literally "sons") one, two, or more at each node. The same phenomenon is seen when the shoots are bent, whether accidentally or by the weight of the fruit, in which case the adventitious shoots are formed only on one side of the shoot.

The primary branches of the coffee tree are arranged in a phyllotaxic order of three-six; that is to say that if, starting at the junction of one of the branches, a line be drawn parallel to the main stem until the junction of another branch be reached, there will be five intermediary branches in a spiral around the stem.

The branches serve to support the leaves, which in the coffee tree are borne in pairs above the nodes and in two different planes, perpendicular to one another. This peculiarity can only be seen by observing the arrangement of the new leaves at the tip of the branch, because as this develops it undergoes a twisting movement which brings all the leaves into the same plane, so that they shall have equal access to the sunlight. Careful observation of the herbaceous part of the branch reveals a longitudinal spiral groove which indicates the twisting which the branch has undergone in the course of its development.

When the coffee tree is subjected to changes of temperature and of precipitation, growth of the branches is not uniform but corresponds to changes in conditions. At the beginning of spring the plant enters upon intense vegetative activity, which is shown in the rapid prolongation of the branch, continuing until the exigencies of nourishment for the fruit divert, to a certain extent, the flow of the sap. The ripening of the fruit, followed on the Pacific side of the country by a pronounced drought and by a fall in temperature, causes an almost complete suspension of vegetative activity, which is seen in the small number of leaves, small also in size, produced during this period. As the branch lengthens, increasing the distance of the terminal bud from the main axis, the zone which represents the period of vegetative activity is correspondingly smaller.

It may be said that the increase in length of the branch during this season of activity will always be approximately half the growth of the previous year ; that is to say, if the branch has grown 50 centimetres in its first year of development, in the second it will reach a total length of 75 centimetres, and in the third barely 87·5. As the fruit of the coffee is only produced along the wood of the previous year, this relationship between the age and the length of the zone of production of the branch must be carefully considered in the practice of pruning.

When the principal axis of the coffee tree develops freely, the tendency is for the sap to nourish chiefly the main bud and the new branches, so that the lower primary branches gradually weaken, and die after two or three crops. The loss of these primaries means a reduction in the productive capacity of the plant ; if, however, the natural course of the sap, which is in an upward direction, be altered, they are provided with better nutrition, and the production of new wood in these branches is greater than that of branches further away from the root system of the plant. In this case the primary thickens considerably, sometimes reaching a diameter of 5 centimetres, and at the same time shows great ramification, forming secondary and tertiary branches, which together form a structure which our farmers call a " crinoline".

PRUNING

The object of the art of pruning is to modify the natural manner of development of a plant so as to obtain a greater abundance of fruit, more regularly, and of better quality, than when it is allowed to develop freely. Pruning modifies both the form and the function of the plant.

The practice of pruning has five main objects, *viz.*—

(1) The production of vigorous trees, strong, healthy, and capable of producing a good crop over a period of several years.

(2) Making the trees a convenient shape for the economic management of the plantation.

(3) Uniform distribution of fruiting.

(4) The production of fruit of good size and quality.

In the coffee tree these objects are pursued by the employment of five different methods of pruning, each with its own special aim. Each of these systems may be conveniently treated according to its necessity for the development of the tree.

PRUNING BY FORMATION

Pruning by formation is practised on the main axis of the plant with the object of producing secondary and tertiary shoots. This operation must be begun when the plant is in the nursery and before it has formed its first primary branches.

The axis is pruned above the third or fourth pair of leaves, in order that the first secondary shoots shall develop, through the activity of the rudimentary buds which are found in the axils of the leaf. These shoots, on account of the position of the buds from which they sprang, will grow forming an acute angle. In order to separate them at the bottom, and to give a better shape to the plant, a small stake or piece of bamboo, about five to ten centimetres long, is inserted between the two young stems, perpendicularly to them. This is done immediately the young shoots have attained sufficient firmness to hold the stick. When the secondary stems have developed more than five nodes, they are again topped above the fifth node, to increase the activity of the adventitious buds and the formation of tertiary shoots. The growth of these last is more rapid if at the time of pruning the primary branches corresponding to the fifth node are also cut away. The desired symmetry in the shape of the tree depends on the formation only of the tertiary stems on each secondary, so that one should eliminate any other stem springing from an abnormal position, as sometimes occurs. At this stage of its development, the plant will have four tertiary stems, and as pruning by substitution will be performed on all of them, we have called them "shoots for substitution pruning".

The tertiaries, like the secondaries, are pruned above the fifth node, giving rise to eight quarternary stems or fruiting shoots. It is desirable that these shoots should grow as slowly as possible, in order that the whole skeleton of the plant below them shall become strong and develop vigorously. This is achieved by not cutting the primaries which correspond to the node above which the tree has been capped. The fruiting shoots, whose life, because of pruning by substitution, will not be more than two years, will be pruned as necessary above the fifth node.

PRUNING BY RESTORATION

This system of pruning is practised on primaries which have borne fruit for two successive years. The practice in Costa Rica is to remove these branches completely as soon as they are no longer capable of bearing fruit, and the result is the formation of haphazard branches of every sort, very thick and rising to a considerable height. The tendency of our system is nevertheless to maintain the zone of fruiting of the plant as near as possible to the

roots, for the reason that, the further away from the roots the fruiting branches are, the longer will the primary grow during an active season, and consequently the smaller will be the crop which the branch can produce. The system of pruning by restoration is applied therefore to all the primaries above a height of about fifty centimetres from the ground ; that is, the branches are cut, when they show signs of weakening after bearing fruit for two years running, at the first and second node from their junction with the stem. Unless the primary has for some reason or other lost its vitality, this pruning produces the development of secondaries, usually one, sometimes two or more, which, during a season of activity, will lengthen almost as much as a primary, and produce a very heavy crop the following year. When this new branch has borne one large or two small crops, it will be restored by the same system, that is to say, it will be cut above the first node from its junction with the primary. It is not always desirable to apply pruning by restoration to all the primaries, as, if these are very numerous one runs the risk of producing very dense foliage, which may make for an unhealthy state.

After three or four years from the commencement of pruning by restoration on a plant, its branches will have become considerably thicker and capable of producing and carrying heavy crops. Since the primaries of a plant do not all appear at the same time, but in succession from below upwards, when the first primaries are restored the second are bearing fruit and the third are preparing for the following crop ; at any given time the tree will be in a good condition of productivity.

PRUNING BY SUBSTITUTION

The skeleton of the tree having been already formed by the method described in the section on pruning by formation, if the tree is left to continue its development freely, the eight quarternary shoots will lengthen indefinitely, each year increasing less than the year before, on account of the greater distance from the root system, and as a result the lower parts of the tree will weaken to a certain extent, these being the parts which are capable of the greatest productivity and which we wish to maintain in as vigorous a state as possible. If these shoots were pruned as they grew longer, the result would be an excessive multiplication which would also tend towards debility in the lower parts and, at the same time, undernourishment in the terminal shoots. To avoid this, the system which we have named " pruning by substitution " should be practised. This consists in pruning, after the first fruiting of the primary branches corresponding to the quarternary shoots, two of the tertiaries above the fourth node, or the one inferior to the fork formed by the two quarternaries. The result is the formation of two new quarternary shoots above the fourth node of the tertiary. This pruning should be carried out on the Pacific side, at the end of the dry season, and on the Atlantic side when the tree shows least activity. The following year the same operation is performed on the two tertiaries which were not pruned the previous year. The third year from the beginning of this pruning, two of the substitution

shoots are cut above the third node, and the fourth year the operation is repeated on the remaining two. This pruning is continued in successive years until the substitution shoots are completely worn out, after which the secondary is pruned above its fourth node, in order to restore the two tertiaries, which, pruned at the fifth node, will serve in subsequent years as substitution shoots. When these latter are worn out, their place will be taken by the branches arising from the tertiaries pruned above the third note.

Theoretically, pruning by substitution would keep the tree young for 104 years, but since, on account of the accidental destruction of the adventitious buds, the new shoots do not always appear at the node above which the branch has been pruned, this result is not obtainable in practice.

PRUNING OF SUCKERS AND ADVENTITIOUS SHOOTS

The *hijos* are shoots growing from the nodes of the vertical stems, below the junction of the primary branches. These shoots are the result of the development of adventitious buds, generally produced by excessive defoliation of the tree, either by diseases in which the leaf is the organ affected, as a consequence of a heavy crop when the tree could not produce new wood, or after a prolonged drought accompanied by strong winds. The usual pruning practice of our farmers consists in destroying these shoots, tearing them out from the base so as to avoid the debilitating effect which they might have on the tree. One should remember that these shoots rise from adventitious buds, and that by destroying them one removes the possibility of their developing if it should be necessary for uniformity of results in pruning by substitution. This danger can be avoided by pruning the shoot above the first node from its junction with the stem. If it is surrounded and covered by the foliage of the plant, its development will be arrested ; but if pruning by substitution reaches the node from which it springs, the adventitious buds beneath its only pair of primaries come into activity and give rise to two vertical stems, one of which is left to take the place of a quarternary.

The suckers (*mamones*) are those which grow from the main stem below its first bifurcation. Since they are near to the roots, their development is rapid and they should be eliminated, for otherwise, they will weaken the whole of the structure above themselves. In a case in which the plant has, for any reason, lost its vigour, the suckers may serve to develop a new and vigorous framework.

PRUNING BY ELIMINATION

This class of pruning consists in the elimination of a complete organ which has permanently lost its vigour, or which has for any reason died and constitutes a menace to the health and life of the tree.

The farmer should keep his trees under constant observation to prevent withered stems or branches from remaining any length of time on the plant and endangering the development of luxuriant growth.

GENERAL PRUNING PRACTICES

Every stem or branch consists of nodes and internodes ; new shoots grow only from the nodes. If when a branch or stem is cut a part of the internode remains, the sap will not rise beyond the node, and all the wood above will die from lack of nutrition. As soon as the material dies, fungi and other saprophytic organisms begin their work of destruction, giving rise to the phenomenon commonly known as decay. The decay extends to the healthy material, and may affect it and endanger the health of the whole plant. It is therefore of the utmost importance that in pruning the cut should be made as near as possible to the node. In this case the cells of the bark continue their work, and rapidly form a covering for the wound, preventing any danger of infection. When the stem which has been cut has a diameter greater than 3 or 4 centimetres, the cut should be painted with oil or tar to exclude all possibility of infection until it is covered by bark.

In pruning primaries and capping tertiaries, it is convenient to use secateurs, as being quicker.

For pruning thick branches, a pruning saw is more efficient and economical than the knife usually employed. If the surface of the cut is large, it is well to use a sharp knife after the saw, in order to leave it completely smooth, which greatly reduces the chances of infection.

ON THE SEEDLESSNESS OF CITRUS FRUITS WITH PARTICULAR REFERENCE TO MARSH GRAPEFRUIT*

A.—INTRODUCTION

CLOSE competition and the rigorous standards demanded by the fruit market may be held largely responsible for the anxious attention now being paid by citrus growers to this problem of "seedlessness". So long as the "seedless" fruit receives its premium, the grower and shipper have to make every effort to standardise that characteristic, and ensure that cases marked "seedless fruit", of whatever variety it may be, shall conform strictly to that specification. Unfortunately seedlessness is a character which, like flavour, cannot be tested and graded except by destruction of the fruit. The onus rests on the grower who must first convince himself that his planting material is absolutely uniform, and secondly, be constantly on the look-out for fluctuations from one cause or another in the standard quality of the fruit he exports. It is with the object of assisting him to know more about the causes of those fluctuations, with a view to remedying them, that the following notes summarising our knowledge regarding seedlessness in citrus have been written.

The position in Trinidad is probably not much different from that in other countries, but receives urgency from the fact that so many plantations are only now coming into bearing for the first time. The remedy for a high percentage of seeded fruit coming from an orchard must be sought and applied as soon as possible, so as to involve the least expense and trouble for the growers, and to prevent injury to the island's reputation for "quality" fruit.

Without making the necessary observations and experiments under local conditions it would be useless at present to advise on the best methods of eradicating seeded fruit or of preventing future recurrence of the trouble. We have only the experience of growers and scientists in other countries to guide us in tackling the problem for ourselves. That experience is on the whole rather meagre, and is culled from acquaintance with several different varieties of citrus in places often differing widely in their climatic and cultural conditions. Bearing this in mind, this survey of the findings of foreign workers may help us to anticipate the results of our own observations, and to suggest ways and means of deriving from them the maximum benefit.

*By N. Wright in *Tropical Agriculture*, Vol. XIII, No. 5, May 1936.

B.—SEED FORMATION IN CITRUS

It will be well to review briefly the mechanism of fruit development in Citrus species, since there are peculiarities in the behaviour of this group not shared by the majority of other fruit trees.

Structurally, they are all many-seeded—that is to say, the young fruits at the flowering stage contain a large number of ovules or seed rudiments. In what may be termed the simpler or more primitive varieties, most of these ovules develop, provided that they are fertilised by pollen derived either from the same plant (self-pollination) or from another plant (cross-pollination). It is important to distinguish between *pollination*, which is the transference of pollen to the stigma of the flower, and *fertilization*, which only occurs after the pollen tubes have grown down the style from the stigma to the ovules, and entered them. If for any reason pollen does not reach the stigma, or having arrived does not grow down to the ovules, not only the ovules themselves but the whole fruit fails to develop. In these primitive varieties, therefore, the fruits if they develop at all contain numerous seeds.

In the more highly developed varieties, failure of seed formation does not prevent fruit development, which is then said to be *parthenocarpic*. In some cases pollination is necessary ; in others it is not. Such parthenocarpic varieties are thus potentially " seedless," though the number of seeds actually found in the fruit will depend upon a number of other factors. If both pollen and ovules are viable, and the pollen grows successfully in the stigmas of the same plant, seedless fruits can only result from causes which prevent pollination, such as an absence of pollinating insects. In some cases, however, although both pollen and ovules are viable, self-pollination is not followed by fertilization and pollen from another variety is necessary before seeds are formed (self-sterility). Pollen from certain other varieties may be equally ineffective (cross-sterility), although some varieties will cross readily.

Not infrequently there is formed some degree of structural sterility, involving either the ovules (female sterility) or the pollen (male sterility) or both, which may be partial or complete. Almost complete structural sterility on both sides is found, for example, in the Washington Navel Orange where it has been demonstrated (Webber 12, Ikeda 4) that the young ovule seldom reaches maturity, and that no fertile pollen grains are formed. Ikeda notes a similar disintegration of the young ovules in the Satsuma mandarin. Nagai and Tanikawa (5), investigating four varieties of tangerines, all with fertile pollen, found that they produced fully-seeded (16-49 seeds) fruit on cross-pollination, but completely seedless fruit when self-pollinated. This example shows us that some functional defect was present to prevent fertilization when self-pollinated, and that the mere fact of proving the viability of pollen on an artificial culture medium does not presuppose its effectiveness on any stigma. It is obvious that whatever the condition of the pollen, partial female sterility will lead to a reduction in the number of seeds that can be formed, and complete female sterility to complete seedlessness. Male sterility, in the absence of any foreign pollen which may be fertile, will have similar results.

In citrus we have an additional complication arising from the fact that so-called " apogamic " seed may develop without fertilization, though not necessarily pollination as well. The progeny of such seed is identical with the mother plant from which it has been derived by vegetative growth. We may find therefore that the pollen of certain varieties, though it fails to effect fertilization, may by some chemical stimulus produce apogamic seeds. It seems possible that in rare instances (Webber. 12) apogamy may occur without even pollination, but this is as yet a matter of uncertainty. The only sure proof is by emasculation and bagging of the flower. It is unsafe to predict how many seeds in a fruit apogamy might account for, but the probability is that a fully-seeded fruit with—say 60 to 80 seeds—could not be explained in this way.

The " Marsh " variety of grapefruit may be called commercially " seedless". Hume (3) describes it as having " two to six seeds or none". We have to ask ourselves—what is the origin of those few seeds, and what unusual circumstances are present to cause a marked increase in their number ? The general consensus of opinion, though at present we have no extensive data to back it, is that Marsh fruit contains either few (say up to 12) or many seeds (say 40 to 80). This rather suggests that the conditions of seed formation are different in the two cases. If the few seeds of a true Marsh are the product of fertilization, then partial sterility must be postulated. In that case one would expect to find intermediate stages of increasing sterility and corresponding numbers of seeds. If, on the other hand, those seeds were of apogamic origin, then the fully-seeded fruit could be explained as the result of accidental pollination by a fertile tree in the neighbourhood.

C.—THE CAUSES OF FLUCTUATION IN THE NORMAL SEED CONTENT

Putting aside the possibility of fruit becoming seedy as a result of abnormal apogamic seed development, it will be clear from what we have said that a seedless fruit must be at least self-sterile. If such a fruit now develops seed, the cause may be twofold : either (1) it has been pollinated by a cross-fertile variety, or (2) it has acquired self-fertility through a genetical change in its constitution—mutation or " sport". In examining the rather conflicting evidence on these two theories, it will be as well to bear in mind the possible effect of the environment upon both of them. We have no proof of its influence, but theoretically we would expect environment to play an important part whichever theory is adopted.

(1) SEEDINESS AS A RESULT OF CROSS-POLLINATION

What appears to be the most completely seedless citrus variety under all circumstances is the Tahiti lime. Uphof (11) from an examination of the structure of the flower, came to the conclusion that seed production was impossible, even with foreign pollen. The same author finds that self-pollination in the Satsuma is structurally impossible, but does not appear to exclude altogether the chances of successful crossing. Tanaka (9) in fact,

says of this variety that "through cross-pollination or under certain conditions favouring apogamic seed formation, a limited number of seeds are formed".

Oppenheimer (6) submits a considerable body of evidence to favour the view that cross-pollination is responsible for at least a part of the increased seediness found in groves of the Shamouti orange. His figures represent the average number of seeds per fruit, estimated from 25 fruit per tree. Eight selected trees, each growing in the vicinity of another citrus variety, were counted in this way, and compared with similar data from eight controls situated at a distance from other varieties. No statistical treatment of the results is attempted, but the author concludes that they "prove definitely" that Marsh grapefruit, Lisbon lemon, and probably Sweet lime are harmless neighbours for the Shamouti so far as seediness is concerned, whilst the other varieties—Valencia, Baladi (a seeded sport of Shamouti), Duncan, Yusuf Effendi tangerine, and Sour orange—all cause an appreciable increase in seediness. These results are at least suggestive, but it is worth noting that the *greatest* difference observed in average seed number per fruit between a control and experimental tree is only 3·78, and the mean difference taking into account the whole 16 trees only 0·75. These differences are not such as would be noticed in commercial fruit, nor of course are they comparable with the very large differences at present concerning grapefruit planters in Trinidad.

Oppenheimer also carried out some controlled hand pollinations using pollen of some of the above-named varieties. The results from one such experiment showed that fruit pollinated with Valencia gave 2·1 seeds as against 0 by self-pollination ; with Baladi pollen 4·2 against 0·9 ; with sour orange 5·0 against 0·6 ; with Sweet lime 0 against 2·3. Four tangerine varieties and the Lu Gim-Gong orange gave in a separate experiment an average of nine seeds per fruit, but no details relating to the number of trees pollinated are recorded. The author also presents figures to show that the flowers of trees giving the larger number of seeds have more viable pollen (as determined by pollen-germination tests), than the flowers of trees yielding sparsely-seeded fruit.

Finally reference may be made to his observation of annual variations in the seed content of a single tree, and his suggestion that weather conditions may be partly responsible, for example by influencing the movements of pollen-carrying bees. This question of climatic effect is an important aspect of our problem, but one about which we have no information. Mention might be made here of Coit's (1) finding that in the Washington Navel orange a higher percentage of mature embryo-sacs were found at Riverside, California, than at Whittier where climatic and soil conditions are different. The same author quotes Ikeda (4) as saying that "cross-pollination between seed-bearing and parthenocarpic varieties (of sweet orange) may result in the setting and maturing of fruit containing viable seeds, provided the pollen used is that of a congenial variety". Unfortunately Ikeda's figures are not available to study this contention.

Various observations on the seedlessness of pummelos (shaddocks) may serve to indicate the possible state of affairs in grapefruit, their nearest relative. From Siam, the home of some of the finest seedless pummelos, we have one or two observations on the constancy of the seedless character. Groff (2) mentions that in one of the best districts of Nakon Chaisi the largest crop is picked in November, " though at other seasons the fruits are more seedless". A photograph in the same article of two half-fruits of the Kao Phuang variety, taken from the same tree but at different times of the year, is striking proof of this fact—the one being completely seedless, the other fully-seeded. Groff has also observed trees bearing seedless fruit, except on branches extending towards other varieties of regular seed-producing habits. Torres (10) records the fact that Siamese pummelos, with a reputation for seedlessness, when introduced into the Philippines contain large numbers of seeds in normal-sized fruit, though small or undersized fruit were more or less seedless. The abundant pollen which the flowers from these trees produced was found, on artificial pollination, to be incompatible and no fruit was formed. Cross-fertilization by other citrus varieties in the neighbourhood was therefore strongly suspected as the cause of seediness.

This view meets with the strong support of evidence obtained with pomelos (a different spelling for pummelos or shaddocks, as used here) in Hawaii by Pope (7). Two distinct crops are obtained in Hawaii—a " spring crop " maturing in April, and a " main crop " maturing in autumn. Fruit from the former, set at a time when few other citrus varieties are in flower, is seedless ; whilst " main crop " fruit set in the spring when other citrus trees are in bloom, is heavily seeded. In order to substantiate the obvious inference from these facts, Pope carried out an experiment on five grafted Victoria pomelos, three of which were growing in a mixed orchard containing varieties of orange, mandarin, grapefruit, lime and lemon, and two were grown apart, in tubs, 360 feet from the orchard " out of the current of the prevailing trade winds". The latter produced nothing but seedless fruit, even in autumn when the other three in the orchard were heavily seeded. Similarly with the Washington Navel orange, Pope notes a larger proportion of seeded fruit than is usually experienced in California, and attributes it, as well as the seediness of Victoria pomelo, to cross-pollination by the Hawaiian orange, a variety often found in orchards and known to have strong seed-producing habits. In California, the most likely congenial variety is the Valenica, but this is itself sparsely seeded and probably low in fertilizing power. The results of Pope's further work, now in progress, with isolated plantings of Victoria and Siamese pomelos, to prove their self-sterility and study possible congenial varieties, will be anticipated with considerable interest.

(2) SEEDINESS AS A RESULT OF MUTATION

There is plenty of evidence in the literature to show that bud-mutation in citrus is a relatively frequent phenomenon. Indeed, so numerous are the variations, involving almost every plant character, which have been recorded as mutations in different varieties—not always with the necessary proof of

their mutational origin—that there is a temptation to ascribe every departure from the normal to this cause. Nevertheless, the increasing attention nowadays paid by planters to this aspect of their crop, and their recognition of its dangers by more careful selection of budwood, leads one to suspect that a fairly widespread occurrence of seediness in a " seedless " variety cannot be entirely explained through its agency.

In spite of that it is impossible entirely to disregard the extensive investigations of Shamel, Scott, Pomeroy *et al.* on this subject (8). Marsh grapefruit was among the commercial varieties examined by them, and it is a significant fact that only in this variety was a mutation found affecting the seed content of the fruit. Out of the 500 trees examined by them, 123 or nearly 25 per cent. gave fruits containing 30 to 90 seeds per fruit. They recognised two strains of seedy Marsh which they called " Rough seedy " and " Smooth seedy". Both had a similar characteristic habit of growth which they describe as " drooping", giving to the tree a somewhat dwarfed appearance. In addition, they were usually poor yielders and marked alternate bearers. The leaves are described as " rather sparse, narrow and very sharply pointed". The following enumeration of the principal characters of the two strains is taken from their descriptions :

" *Rough Seedy Strain.*"—Skin coarse, dull yellow, rind c. ½ inch thick ; flesh straw-coloured, carpels 12 to 14, rag coarse and unpalatable, vesicles long and large ; core usually open, c. 1½ inches diameter ; juice abundant, v. acid, poor in flavour ; seeds very large—about 50 per fruit.

" *Smooth Seedy Strain.*"—Fruit flattened, smooth in texture, rind ivory-white. Very similar in outward appearance to the Marsh strain. Number of seeds usually about 50. Often found on trees with the rough seedy strain. Flesh and juice similar to the latter.

This is the most definite information we have regarding mutations affecting seed content. We may add to that Oppenheimer's (6) opinion that cross-pollination is only one of the factors contributing to seediness in Shamouti. He draws attention to the fact that seeded trees are sometimes found in places isolated from other citrus species, and also discusses the significance of the variety called Baladi which is known to be a seeded sport of Shamouti. Baladi is recognisable on other characters besides seediness, and in some orchards appears fairly frequently, leading to contamination of the crop by inferior fruit. We have here it seems a parallel case to the seedy strains of Marsh. Oppenheimer suggests that the Shamouti may not always mutate to all the characters of typical Baladi, and that seeded Shamouti oranges may be regarded as partial Baladi sports. The proof of this contention lies of course in testing their budded progeny.

D.—THE REMEDY

From the previous discussion, we have seen that there are at least two sets of circumstances which separately or together may offer a reason for an increase in the seed content of a single " seedless " citrus variety. The remedy

will naturally depend upon which of these two factors the results of our practical experiments place the greater importance. At the outset emphasis must be laid on the necessity of ascertaining with certainty that only one variety is concerned, and that no mixture of types, including seeded varieties, has occurred in the course of planting. Varieties of citrus are not always so distinct that they can be exactly distinguished from each other when mixed in the field. In the case of grapefruit, separation is sometimes well-nigh impossible on the basis of botanical criteria, and we are left with the unsatisfactory alternative of judging by such characters as habit, bunching of fruit, colour of flesh or taste, which, relying on personal judgment, is apt to be independable.

Classification and accurate description of horticultural varieties in general can only be made reliable by collecting them into one place for the purpose of keeping comparative records of their habit, growth rate, yield and general behaviour under uniform conditions. Differences between one variety and another may be so small that only by growing them side by side in adjacent plots can they be separated on reasonable grounds. Moreover, descriptions based on such observations must inevitably differ in detail from those of another observer in a separate locality.

It is only begging the question to use the number of seeds as a criterion of variety in this case. By so doing, we ignore the existence of the two factors already spoken about, and this is an untenable view. The fact is not ignored, however, that trees consistently bearing seeded fruit should be regarded with suspicion, and an attempt made to trace the origin of their budwood. At any rate, whether mistakes in budding or distribution can be proved or not, the remedy will be the same as for seedy trees whose origin in mutation has been proved by budding. It should be mentioned here that in re-budding, care should be taken that foreign pollen is excluded from the tree ; it would be safer to carry it out in quite a different locality.

The remedy consists in either (*a*) replacing the tree by another, or (*b*) top-working the existing one. Choice of these two alternatives will mainly depend on the age of the tree, the number of trees to be so worked, and the skill of the operator. Where the age of the trees is fairly advanced it will probably be more economical to top-work, only providing that the labourers possess the necessary ability. The method adopted must fully justify its cost, and to those unfamiliar with top-working, a few years lost by raising new plants will be repaid in the better trees they ultimately obtain.

If the seediness of our fruit can be proved not to be transmissible by budwood, we must look to other means of remedying the situation. Concentrating first on the possibility of cross-pollination by congenial varieties near to or within the orchard, these must be sought after by means of observations on the time of their flowering, and the coincidence of this with the period of grapefruit bloom. Their removal can be the only effective safeguard against crossing taking place in future years. Mixed orchards are at all times to be

deprecated, and every effort ought to be made to eradicate other varieties where they can be recognised. This should apply even to reputed " seedless " types, since their pollen, though it may be self-sterile, may be fertile with the variety under cultivation.

Attention at this point should be drawn to the possibility of both cross-pollination and mutation operating together. One or perhaps a few trees in the orchard may " throw " a seeded sport bearing pollen which is fertile to the " seedless " variety in question. In this way, a single mutant tree, or even only a limb of the tree, may produce seediness in a number of trees growing near to it. Oppenheimer (6) suggested that this may be the explanation for the reported steady increase in seediness from year to year in a grove of Shamouti oranges in Palestine. An increase in the number of limbs sported to Baladi has here resulted in a greater abundance of fertile pollen being available for seed formation in the adjacent Shamouti flowers.

The only way a grower has of keeping a check on the seediness of his fruit is by counting the number of seeds in a representative sample from each tree. Trees found to bear seedy fruit should be distinctly marked, and their crop marketed separately until an opportunity occurs to remedy the cause. It is suggested that such trees, when found, should then be examined more closely in order to determine if the seeded fruit are confined only to particular branches. If that is the case, and *if counts in subsequent years confirm the fact,* the grower would be justified in removing the branch on the assumption that it was a mutation. Unless such records are repeated in successive seasons, he has no guarantee that the variation was anything but fortuitous.

E.—METHODS OF INVESTIGATION

The problems confronting us are purely local in character. From the rapid survey we have made of the results of observers in different foreign countries, we have obtained some insight into the potentialities of citrus fruit in regard to seed formation. These discoveries have to be borne in mind all the time, but they do not answer our local problems. They do, however, suggest two avenues of preliminary approach :

(i) Seed counts of fruit from trees in localities differing with respect to rainfall, soil, aspect, manuring, age, time of flowering and proximity to other citrus species.

(ii) Artificial pollinations to discover which varieties are fertile to Marsh grapefruit, and their effect on seed number.

(i) The principal difficulty in regard to seed counts lies in deciding how many fruits from each tree must be examined to give a valid estimate of the number of seeds per fruit. Shamel, Scott, Pomeroy, *et al.* (8) in their study of bud mutations in Marsh grapefruit separated the fruit into three grades : (*a*) Ivory-white, (*b*) Standard, (*c*) Culls, and from each took three—small, medium and large-sized—fruits. Thus nine fruits per tree were examined yearly for seed number. In this way they obtained a good random sample

but their method, entailing the picking of all fruit from the tree before sampling, is not one which could be practicably applied to commercial estates by the grower himself. He must normally be content to pick his sample direct from the tree, and in so doing attempt to sample all parts of the tree—on all sides, and from the upper as well as the lower branches. Such selection is not strictly at random, but by taking rather more fruits from each tree a fairly reliable estimate should be obtained. Oppenheimer (6), as a result of calculations based on counts from 300 fruits *of a single tree*, concludes that 25 fruits are sufficient to prove real differences between two trees in 95 per cent. of cases. Whilst it would have been more satisfactory to have estimated this minimum number from the records of several trees, it is probable that this figure will be found adequate for practical purposes. Once again, we should stress the need for computing the number from local data, and not placing too great reliance on figures which are the result of totally different environmental circumstances.

(ii) Pollination experiments need not be elaborated here in any detail. The procedure is more or less straightforward, the main difficulties being to obtain pollen from selected pollen-parent as and when required, and to cover a sufficient number of estates and trees in the brief time a single flowering season will allow. In this connection, intensive work on a few trees will probably yield more valuable results than a number of scattered pollinations embracing a greater number of estates.

The above suggestions will suffice only for a preliminary survey of the situation. Further, more intensive research must await the indications which the data from that survey should provide. In order that the information obtained should be representative of as wide a range of conditions as possible, it will be better at present for the observations to be carried out on different commercial estates throughout the island, rather than to study a small experimental area of clonal trees. The scope of the investigation may have to be narrowed with such a broad field to cover, but the results should be of more immediate value to the grower as a whole.

In conclusion, a plea is forwarded to those concerned in this problem, to free their minds from preconceived ideas on the subject. The solution to the riddle is not likely to be a simple one, a hint as to its complexity will be provided by these notes, so that only carefully recorded and controlled experiments will give any satisfaction when the time comes to apply the remedy.

ACKNOWLEDGMENT

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MINUTES OF THE SEVENTH MEETING OF THE CENTRAL BOARD OF AGRICULTURE

THE seventh meeting of the Central Board of Agriculture was held at Peradeniya, in the Board Room of the Department of Agriculture, at 2 p.m. on Thursday, 14th May, 1936.

Mr. E. Rodrigo, C.C.S. (Acting Director of Agriculture) presided and the following members were present :— Messrs. S. Armstrong, C. Arulambalam, A. C. Atygalle, L. S. Bertus (Acting Mycologist), R. G. Coombe, M. Crawford (Government Veterinary Surgeon), E. C. de Fonseka (Jr.), Wace de Niese, L. W. A. de Soysa, R. P. Gaddum (Chairman, Planters' Association of Ceylon), Bruce S. Gibbon, Dr. J. C. Hutson (Entomologist), Dr. A. W. R. Joachim (Agricultural Chemist), Messrs. L. Lord (Principal, Farm School), E. H. Lucette, C.C.S. (Registrar, Co-operative Societies), S. M. K. Madukande Dissawe, R. K. S. Murray (Acting Director of Research, Rubber Research Scheme), Mudaliyar S. Muttutamby, Dr. R. V. Norris (Director, Tea Research Institute), Messrs C. E. Graham Panditteseke re, Wilmot A. Perera, Dr. H. M. Peries (Chairman, Low-Country Products Association), Messrs. W. V. D. Pieris (Acting Chief Technical Officer, Coconut Research Scheme), F. A. E. Price, E. L. Spencer-Schrader, B. M. Selwyn, Rolf Smerdon, U. B. Unamboowe, Ratemahatmaya, Mudaliyar N. Wickremaratne, Messrs. G. V. Wickremasekera (Acting Economic Botanist), A. A. Wickremasinghe, Revd. Father L. W. Wickremasinghe, Mr. C. L. Wickremasinghe, C.C.S. (Commissioner of Lands), Mr. C. Huntley Wilkinson, Col. T. Y. Wright (Ceylon Estates Proprietary Association), and W. C. Lester-Smith (Acting Secretary).

Visitors.—Messrs. C. N. E. J. de Mel, F. P. Jepson, L. A. P. Pieris and A. V. Richards.

Intimation of their inability to attend the meeting was received from the following members :— The Hon'ble Mr: J. L. Kotalawala, M.S.C., Gate Mudaliyar A. E. Rajapakse, M.S.C., Mr. E. C. Villiers, M.S.C., Mr. D. H. Kotalawala, M.S.C., Messrs. James Forbes (Jr.), G. W. Bruce Foote and Col. K. D. H. Gwynn.

Prior to commencing the proceedings of the meeting, the Chairman referred to the death of His Majesty King George V. Although this sad event had receded from them by a lapse of several months, he considered it proper that they should pay their homage to His Majesty's memory on this their first meeting after his death. He requested the meeting to show their sympathy in the usual way. This was done, all members standing in silence.

The Chairman next referred two sad events in the Island. One was the death of Mr. C. E. A. Dias, one of the most prominent agriculturists in Ceylon.

He desired to mention the fact that Mr. Dias had shown a special interest in the activities of the Central Board of Agriculture. He was a foundation member of the previous Board and took a most active interest in all its work ; he was a member of the present Board and of its Executive Committee. His agricultural interests, while being very wide, as everyone knew, centred intensively on two subjects, namely, the budding of rubber and soil erosion. He was sure, the Chairman said, that all interested in those subjects of great importance to the agriculture of Ceylon, would admit that the contributions of Mr. C. E. A. Dias were greater than that of any other man in this country. They would miss his advice and the very valuable contributions he always made to the deliberations of the Board of Agriculture.

The other death, the Chairman said, to which he had to refer was that of Sir Henry de Mel. He was not a member of the present Board but was a foundation member of the original Board of Agriculture, and he had taken a very great interest indeed in its activities. His interests were very much wider than those of Mr. C. E. A. Dias, but they did not tend to make his interests in agriculture less intensive ; the agriculturists of Ceylon would greatly deplore his loss.

The Chairman said that he considered it would be the desire of the Board to express their great sorrow at the death of these two gentlemen and to pass a vote of sympathy with their relatives. This was done in the usual manner, all members standing.

CONFIRMATION OF MINUTES

The Chairman intimated that the minutes of the last meeting had been printed and circulated to all members. Unless any member desires to make any comments before confirming them he would take the minutes as confirmed.

Mr. Wilmot A. Perera indicated that on page 15 of the minutes the words "Kalutara Committee" should be amended to read "Kalutara Planters' Association". After this amendment had been duly made the minutes were confirmed and signed by the Chairman.

CHANGES IN MEMBERSHIP

The Chairman announced that the following changes had to be recorded since the last meeting of the Board :—

Mr. Bruce S. Gibbon, nominated by the Kandy District Agricultural Committee, in place of Mr. P. B. Ranaraja.

Dr. H. M. Peries becomes an *ex-officio* member of the Board on election as Chairman, Low-Country Products Association, vice Mr. L. W. A. de Soysa.

Mr. L. W. A. de Soysa, nominated by the Low-Country Products Association, in place of Mr. S. Pararajasingham, resigned.

Col. T. Y. Wright, nominated by the Ceylon Estates Proprietary Association, in place of Mr. H. F. Parfitt, M.S.C., resigned.

Col. K. D. H. Gwynn, re-appointed to his seat on the Board which he vacated owing to absence.

The Chairman then intimated that the vacancy created by the death of Mr. C. E. A. Dias remained to be filled. He also pointed out that the nomination of a member was necessary to fill the vacancy on the Executive Committee of the Board, and asked for nominations. Mr. C. Huntley Wilkinson proposed the name of Mr. Wilmot A. Perera ; this was seconded by Mr. R. P. Gaddum, and carried unanimously.

In answer to a query by Mr. Wace de Niese, the Chairman indicated that the vacancy on the Central Board caused by the death of Mr. C. E. A. Dias was one of the nominations of the Director of Agriculture.

JAFFNA-PUNAKARYN CAUSEWAY

The Chairman said that the next item for consideration was a motion by Mr. C. Arulambalam which had been postponed from the last meeting. The resolution proposed was as follows :—

> " The Central Board of Agriculture is of opinion that the construction of a permanent causeway to connect the Jaffna Peninsula with the Punakaryn Division of the Jaffna District is urgently needed in the interests of the Agricultural Development and colonisation of the Punakaryn Division, thereby helping to relieve unemployment and congestion of population in the Jaffna Peninsula, and recommends to the Executive Committee of Agriculture and Lands the favourable consideration of this question."

Mr. Wilmot A. Perera asked the Chairman on a point of order whether the Board was competent to discuss such resolutions which were related to purely local problems.

The Chairman asked Mr. Arulambalam if he had any comments to offer on the point of order raised on this resolution.

Mr. Arulambalam said that the Executive Committee of Agriculture and Lands in a report presented to the State Council on June 13th, 1933, defined the functions of this Board ; one was that it should submit to the Executive Committee of Agriculture and Lands resolutions and proposals for the agricultural advancement of the Island. That report further stated that the Central Board of Agriculture should have no executive authority but should function solely as a deliberative and advisory body. It could make representations and recommendations through its Executive Committee to the Ministry for Agriculture and Lands, or through this Ministry to other Ministries for the promotion of the agricultural interests of the Island. Mr. Arulambalam submitted that under the constitution of this Board the resolution which he proposed came within its scope and should meet with their approval and support.

The Chairman ruled the resolution out of order as not being one for discussion by the Central Board of Agriculture and the subject was dropped.

IRRIGATION FACILITIES IN THE PUNAKARYN DIVISION

The Chairman called upon Mr. C. Arulambalam to speak on his second resolution, which had also been postponed from the previous meeting.

Mr. C. Arulambalam indicated that the object of his resolution in this connection was to obtain a survey of the irrigation facilities in the Punakaryn Division so that a co-ordinated irrigation scheme for that Division could be prepared. He understood, he said, that the Irrigation Department had taken in hand the improvement and restoration of certain small tanks, such as Pallavarayan, Kaddukulam, Maniyankulam and Kunchukulam. Continuing Mr. Arulambalam quoted from a communication, dated January 1928, from Mr. C. V. Brayne, then Additional Controller of Revenue, to the Government Agent, Northern Province, in support of his resolution. Mr. Arulambalam commended his resolution to the favourable consideration of the Board, and pointed out that the matter concerned the agricultural progress of an important area.

Mr. Arulambalam then moved the following resolution, which was seconded by Mudaliyar N. Wickremaratne :—

> "The Central Board of Agriculture is of opinion that with a view to fuller agricultural development and extension of cultivation of agricultural products in the Punakaryn Division of the Jaffna District, a survey be made of the irrigation facilities available at present in the Punakaryn Division with a view to have these facilities improved at an early date and recommends the favourable consideration of this question to the Executive Committee of Agriculture and Lands."

There being no further comments on this subject, the Chairman put the resolution to the meeting. Ten members voting for the motion and none against, this resolution was passed.

SUPERVISION OF PADDY CULTIVATION

The Chairman called upon Mudaliyar Wickremaratne to speak on the resolution standing in his name.

Mudaliyar Wickremaratne pointed out that immediate supervision was necessary for the systematic cultivation of paddy. At present, he said, departmental officers did a great amount of work, but this was largely in the nature of experimentation and there was no systematic supervision of cultivation. If the Divisional Agricultural Officers kept statistics of the areas under paddy cultivation and the acreage that could be planted at different periods, supervised cultivation, seed supply and found out the various seasons, he considered it would be much easier for the cultivator to undertake the sowing of fields. Up to date, he continued, no such thing was done. The services of Vel Vidanes had not given satisfaction and if Agricultural Instructors and Divisional Agricultural Officers took a keener interest and supervised the

cultivation through the Vel Vidanes, he thought a larger area could be brought under paddy cultivation and a greater quantity of paddy produced. For this purpose he thought that the number of Agricultural Instructors would have to be increased. In the 19 districts of the Island there were about 101 or 102 Chief Headmen's divisions ; in some there were Agricultural Instructors, but in other divisions there were none. He considered that the additional expenditure would be justified as it would increase local rice production and stop a good deal of money going out of the country. According to his calculations an expenditure of from three to five lakhs of rupees would be amply justified as during the last malaria epidemic, according to the report of the Relief Commissioner, Rs. 8,045,000 was spent on relief alone. If sufficient interest in paddy cultivation had been taken earlier, he considered that a good deal of this money would have been saved.

Mudaliyar Wickremaratne then moved this motion which was seconded by Mr. Wace de Niese.

Mr. S. Armstrong, speaking in support of the motion, mentioned that on September 19th, 1935, the Board had adopted his motion that persons with agricultural diplomas be selected for training in irrigation and water distribution to enable them to supervise paddy cultivation. If this motion were adopted by the Executive Committee of Agriculture and Lands the motion of Mudaliyar Wickremaratne would be automatically embraced.

After some further discussion on the subject of Vel Vidanes, Mr. Wilmot A. Perera said he felt it was desirable that they should be placed under the Agricultural Officers, but he believed the crux of the matter was that there were administrative difficulties and that the irrigation Ordinance would have to be amended.

Dr. R. V. Norris intimated that a year ago he had visited Java and seen some of the conditions there, the area of Java was about twice that of Ceylon, but its population was between 45 and 50 million, as compared with under 5 million in Ceylon. In spite of this Java was practically self supporting in the matter of rice growing, and imported a very small quantity of rice. It had struck him very forcibly that if Java with its large population managed to produce its own rice, it was rather startling that Ceylon with its much smaller population should have to import large quantities. If the suggestions put forward could assist in a more intensive cultivation of rice in this country, he considered they should adopt them.

After further discussion Mr. C. L. Wickremasinghe pointed out that the Vel Vidane was really an irrigation headman. He was an elected officer and has certain specific duties. He did not consider it would be fair to try to burden this elected officer with any special duties until his status was altered by some such method as suggested by Mr. Wilmot Perera or otherwise. He suggested that the mover should omit the last part of his motion ; the Vel Vidane being an officer elected by the cultivators, it would not be right for others to impose on him additional duties which he would have to perform.

The mover, Mudaliyar Wickremaratne, and the seconder, Mr. Wace de Niese, being in agreement with this view, the following amended motion was put to the meeting and carried unanimously :—

> "That this Board is of opinion that in order to increase the local production of rice the systematic supervision of the cultivation of paddy by Divisional Agricultural Officers and their assistants is necessary."

ORGANIZATION AND CO-ORDINATION OF DIVISIONAL AGRICULTURAL ASSOCIATIONS

The Chairman, in calling upon Mudaliyar Wickremaratne to open the discussion, pointed out that this subject was liable to lead to very desultory discussion without any very definite aim ; he suggested that any suggestions to achieve the end in view might be more usefully put forward in the form of a resolution.

Mudaliyar Wickremaratne intimated that his idea in bringing up this subject was that the Board might discuss the matter and make some decisions which would have the object of making the Divisional Agricultural Associations more useful to the village agriculturists. He agreed with the remarks of the Chairman and he would suggest what he considered necessary in the following resolution :—

> "That this Board is of opinion that the services of an agricultural officer should be requisitioned for at least one year for special duties in the organization and co-ordination of the Divisional Agricultural Associations."

In speaking on this resolution Mudaliyar Wickremaratne pointed out that the District Agricultural Committees and Divisional Agricultural Associations were subsidiary bodies to the Central Board of Agriculture. The Divisional Associations were presided over by the Chief Headmen, and the District Committees by the Government Agents or Assistant Government Agents. One of the objects of the Divisional Agricultural Associations was to bring agricultural information to the door of the villager, but he had noted from reports in the Press and from the feelings of members that they were not functioning successfully. Even the Minister of Agriculture himself, at a recent meeting at Panadura, had implied that they were not all functioning satisfactorily. It was true that these Associations had a representative membership, composed as they were of representatives of Village Committees, Co-operative Societies and members nominated by the Chief Headmen, with the Agricultural Instructor of the Division as Secretary. The majority, however, were not functioning satisfactorily owing to lack of organization. He considered that they should receive some form of extraneous assistance, and that if an officer of the Agricultural Department could devote his time for at least a year to visiting the associations and co-ordinating their work they would function more satisfactorily.

Mr. C. Arulambalam, in seconding the resolution, agreed that some form of co-ordination was necessary in order to make the experience of the associations available to each other. He intimated that in Jaffna the Divisional Associations were doing good work, but he felt that funds should be made available for them to lay down demonstration plots.

Mr. S. Armstrong, speaking as a member of a Divisional Association, said that members of these associations had a feeling of a lack of responsibility. The early meetings were punctually attended and many matters were discussed, but they found that nothing came of the resolutions that were passed and forwarded to the District Committees and the Central Board of Agriculture. Many of the members came long distances and on their return had nothing to report to the villagers. He considered that funds should be allocated to Divisional Associations for village shows, etc., and that they should be informed of the action taken on their resolutions.

Mr. Rolf Smerdon supported this and pointed out that the whole trouble was the total lack of executive authority on the part of the Divisional Associations. The greatest drawback was that they could do nothing except discuss matters and pass resolutions. He was a member of the Ruanwella Divisional Association ; he knew that the Minister did not wish the Divisional Associations to have any executive authority any more than he wished the Central Board or the District Committess to have it ; but it was this that dissatisfied the Divisional Associations and led to a total lack of enthusiasm and eventually to their becoming moribund.

The Chairman enquired if it were suggested that the absence of executive power and not lack of co-ordination which was the trouble ; as, if so, this appeared to be departing from the resolution which advocated co-ordination by the appointment of a special officer.

Mr. Lucette intimated that what appeared to be the trouble with Divisional Associations was lack of effective representation of the villager himself on the Board ; to express the views of the villager on such a matter as the duties of Vel Vidanes, for example.

Mr. Wilmot A. Perera pointed out that Divisional Agricultural Officers already acted as co-ordinating officers ; he did not know what results the appointment of another officer would bring about ; the whole problem he thought was the land problem. As regards the allocation of funds, he thought funds were allocated ; the Divisional Agricultural Officer in his area had organized competitions for fodder grasses, etc., the funds for which he believed came from the Agricultural Department.

Mr. L. Lord supported the views of the previous speaker that the co-ordination of the activities of Divisional Associations was performed by the Divisional Agricultural Officers ; when he was in charge of the Eastern Division, funds were allocated to each Division for holding competitions. Demonstration plots, which had been referred to by a previous speaker, were arranged for also, through the medium of the Divisional Associations. He did not consider that the fault lay in lack of organization or co-ordination of the work, or in funds not being made available. Mr. Rolf Smerdon stated that his

experience was that funds were voted by the Department for special purposes ; they had no vote in their disbursement, all they did was to watch them distributed.

Mudaliyar Wickremaratne, in reply, said that while some Associations were working well, others were not; that alone indicated that some co-ordination was necessary.

The resolution was then put to the meeting and passed by nine votes to four, the remaining members abstaining from voting.

ADVISORY SUB-COMMITTEE ON ANIMAL HUSBANDRY

Mr. R. P. Gaddum, on behalf of the Executive Committee of the Central Board, proposed the following resolution which had been passed unanimously at the last meeting of that Committee :— "That the Executive Committee of the Central Board of Agriculture recommends the constitution of a permanent Sub-Committee consisting of four members to advise the Board on the question of animal husbandry, and that this sub-committee be empowered to co-opt others. It further recommends that Messrs E. C. de Fonseka (Jr.), L. W. A. de Soysa, Rolf Smerdon and M. Crawford (Government Veterinary Surgeon), do form the Sub-Committee, and that the Government Veterinary Surgeon be appointed convener."

Mr. Wace de Niese seconded this resolution.

Mr. C. Arulambalam urged as an amendment the advisability of adding to the proposed personnel of the Sub-Committee a representative of the dry zone areas of Ceylon in view of the special problems connected with these areas.

Mudaliyar Wickremaratne seconded this proposal.

After some further discussion the resolution was finally adopted by the Board in the following form :—

> " That the Central Board of Agriculture recommends the constitution of a permanent Sub-Committee consisting of five members to advise the Board on the question of Animal Husbandry, and that this Sub-Committee be empowered to co-opt others. It further recommends that Messrs E. C. de Fonseka (Jr.), L. W. A. de Soysa, Rolf Smerdon and M. Crawford, (Government Veterinary Surgeon) together with one member to represent the dry zone, do form the Sub-Committee, and that the Government Veterinary Surgeon be appointed convener."

The election of a member to represent the dry zone on this Sub-Committee was then taken up, and after some discussion Mudaliyar S. Muttutamby was elected to the Sub-Committee.

SOIL EROSION

The following resolution which had been passed unanimously by the Executive Committee of the Central Board at its last meeting was then placed before the meeting for consideration :—

> " From the investigations made, it appears that the larger proportion of estates still use scrapers. The Executive Committee of the Central

Board of Agriculture therefore recommends that legislation be introduced during the year 1938 to stop this practice."

In connection with this proposal the Chairman stated that he wished to bring to their notice the following paragraph which appears on page 42 of the Report of the Committee on Soil Erosion (Sessional Paper III of 1931) :— "The Committee recommends that before any new legislation or amendment of existing legislation affecting estate agriculture is introduced, the terms of the proposed legislation be referred to the various planting associations." He considered this recommendation quite right in principle ; from the replies received to the questionnaire on soil erosion issued to estates, it was apparent that 81 per cent. of the tea estates stated that they used scrapers. For the Board to recommend legislation in defiance of that practice, and without consulting the planting industry, would be most unwise. The Chairman recommended, therefore, that he be authorized to take action to consult these planting interests and, in the meantime, to hold up the recommendation until he had received an expression of their views.

The meeting was in unanimous agreement with this suggestion and the subject was postponed.

SPOTTED LOCUST

Mr. C. Huntley Wilkinson proposed the following resolution :—

"That as the Central Board of Agriculture is of the opinion that the prescribed measures for the control of the Spotted Locust will prove ineffective, this Board recommends that the present regulations relating to the Spotted Locust (Aularches miliaris L.), published in the *Ceylon Government Gazette* No. 8,201 of February 7, 1936, be rescinded."

Speaking on this resolution, Mr. Huntley Wilkinson said that they would be aware that a detailed study of the life history of the Spotted Locust was carried out in 1926. The female of the species was about two inches in length and laid egg masses about one and a half inches long. There were three periods during its life history of twelve months when this pest was vulnerable, namely : (1) When the adults were making, during October, November and December, their movements were sluggish and they could then be crushed, drowned or otherwise killed ; (2) when the eggs were in the ground, November to March, they could be dug up and destroyed: (3) when the young hoppers were emerging, February to April, the egg masses should be watched and the young hoppers emerging should be caught. This subject, he continued, first came before this Board in May last year, when it was on the agenda but not debated because the mover of the resolution was not present at that meeting. It was eventually debated in September last year, and the decision arrived at was that the Spotted Locust be declared a pest under the Plant Protection Ordinance in the Tyspane Korale of the Kotmale Division. No indication of any motion to this effect was on the agenda for that meeting, and the Chairman of the Planters' Association protested that the resolution should be forwarded first

to that body and to the Tea Research Institute for their considered opinion, because he thought that legislative measures should be resorted to only in extreme cases, and the way did not seem to be clear to make them effective. The amendment to defer consideration was defeated, however, by 11 votes to 9, though the Chairman himself advised postponement. Eventually, in the *Government Gazette* of December 20, 1935, the Spotted Locust was declared a pest under the Plant Protection Ordinance, No. 10 of 1924. A further notification appeared in the *Government Gazette* of February 7th, which was as follows : " All egg masses of Spotted Locust (Aularches miliaris L.) shall be forthwith dug up and destroyed between September 1 and March 1 each year, or so exposed to weather conditions and natural enemies as to prevent such eggs from hatching," and the *Gazette* of February 14th made it clear that the Tyspane Korale in the Kotmale Division was the only area concerned. A planter in this area had now pointed out that he had been unable to find any of their breeding places and that he was of the opinion that the eggs were laid in the Crown jungles adjoining tea estates and that it was up to the Government, who declared the Spotted Locust a pest, to dig up these egg masses and destroy them. Managers of large estates, he said, were perfectly willing to take the necessary measures on their estates if they could find the egg masses, but he felt that the meeting would not contradict him when he said that the villagers would not be able to do anything about it, partly because Buddhist cultivators had an objection to curtailing the life of any living thing. It appeared to members of the Planters' Association that the mere exposing of the egg masses to the depredations of birds, and nature generally, only on tea estates, was not a practicable measure of elimination. In support of this contention Mr. Huntley Wilkinson quoted extracts from the opinions expressed by members of the Standing Committee for agriculture of the Planters' Association of Ceylon.

Mr. R. P. Gaddum seconded the resolution and reserved any remarks he had to make till a later stage in the discussion.

Mr. Rolf Smerdon pointed out that the mover of the original motion to declare this insect a pest, had stated that garden crops were attacked and that the villagers were unable to carry out measures owing to religious scruples. This being the case, what hope was there that declaring it a pest would have any effect on the villagers ? If, as was said, the insect bred in the Crown jungle, what right had they to enter Crown land ? They only laid themselves open to legal action. He considered that the prescribing of such measures was making the law ridiculous. He supported the resolution that the regulations be rescinded and suggested that some other feasible means be devised for exterminating the pest.

Mr. U. B. Unamboowe, Ratemahatmaya of Kotmale, stated that this pest originally appeared in one village, namely Harangala ; but it had now spread to five villages. Vegetable crops were being destroyed and he considered that Government should take some steps to prevent the pest spreading. If some-

thing were not done he was sure it would spread to estates. It was because the villagers would not take any measures against this pest that he had brought up the original resolution ; he thought that steps ought to be taken to compel the villagers to destroy the pest, otherwise he feared much damage would be done.

Dr. J. C. Hutson (Entomologist) said that an outbreak of Spotted Locust occurred in Tyspane Korale during 1934. The prescribed measure actually scheduled under the Ordinance for the control of the Spotted Locust, was the digging up and destruction of the egg masses. This was the only one of three measures available which could be carried out by villagers as a routine cultural operation without offending their religious susceptibilities. Obviously this measure alone could not be expected to control the pest satisfactorily, but there was no objection to the other two measures being employed by villagers if they really meant business. All three measures had been employed on estates with good results. As regards the feasibility of the measures recommended, he doubted whether the villagers would accept any measures as feasible as they were fully persuaded that the Department should control the pest for them.

Mr. R. P. Gaddum said that before this discussion concluded he would like to give his reasons for seconding the resolution proposed by Mr. Huntley Wilkinson. He felt that the principle of the Board supporting a resolution which aims at declaring a pest without first obtaining considered opinion on the subject was most undesirable and likely to cause a certain amount of justifiable criticism. For instance, to expect all agriculturists to dig up egg masses of the Spotted Locust between September 1st and March 1st each year was surely quite impracticable, especially when it was stated by those with experience that these insects laid their eggs on Crown property, such as Government stream reserves. Nor was it reasonable to expect planters or others to put on observers with a view to locating the descent to the ground of adult females for oviposition purposes ; they obviously had not got time to do this themselves as the average planter, to use a medical analogy, must be regarded more as a general practitioner than a maternity specialist. He considered that before they asked for an insect or anything else to be declared a pest under the Ordinance, they should first satisfy themselves that practicable measures could be devised for its control, measures which had first been submitted for the criticism and advice of those concerned.

Mr. Unamboowe suggested that some investigations be made as to the incidence of the pest and how best it could be controlled.

The Chairman in closing the discussion stated that he would give them an undertaking that he would take steps to have further investigations made as to what practicable methods of control could be devised.

The resolution was then put to the meeting and carried unanimously.

INFORMATION REGARDING THE ACTION TAKEN ON RESOLUTIONS PASSED BY THE CENTRAL BOARD AND OTHER AGRICULTURAL ADVISORY COMMITTEES

Mr. S. Armstrong proposed the following resolution :—

> " This Board is of opinion that better results could be obtained by the Agricultural Advisory Committees if the Executive Committee of Agriculture and Lands will be pleased to place before this Board and other Agricultural Advisory Committees, the actions taken by them with regard to the resolutions passed by these respective bodies and forwarded to them for their consideration."

Speaking in support of this resolution, Mr. Armstrong said that there was no doubt that the Ministry of Agriculture greatly appreciated the counsel and advice of its consultative bodies and often acted upon their recommendations. On the other hand there was no means whereby the advisory associations were kept informed as a matter of course of the result of their deliberations and proposals. Also there might be recommendations made by these bodies which the Ministry, for various and excellent reasons, were unable to implement. He felt that, whatever the result, it would add greatly to the interest and usefulness of agricultural advisory committees, if, instead of being kept in the dark as at present, effect could be given to the suggestions incorporated in his resolution.

Mr. L. W. A. de Soysa formally seconded the resolution.

The Chairman informed the meeting that on receipt of the notice of the resolution he had communicated with the Hon'ble the Minister for Agriculture and Lands and had asked him for his views on what could be done to satisfy this natural curiosity of the members. A reply had been received, and the Secretary read the reply from the Ministry of Agriculture and Lands.

The letter from the Ministry indicated that it would involve considerable difficulty to keep the Board informed of each step of the action taken on their resolutions. The final action taken on a resolution could be communicated, but this would be perhaps of no value as this information would already be available. The members of the Board could be assured that the Hon'ble the Minister for Agriculture and Lands fully realised the value of their advice in the agricultural development of the Island and that the greatest weight was attached to all resolutions of the Board.

The Chairman intimated that he might supplement this answer with a statement of his own. It had been suggested that he himself might make a statement with regard to the action taken on resolutions passed by the Board, and he considered that this would be most useful. He assured them that in future he would make a short statement, immediately after the minutes had been confirmed, on the action taken on each of the items of the preceding agenda, in so far as he could do so without compromising the Ministry which determined policy. They would appreciate, he said, that a certain amount of

reserve was necessary in these matters while action was being formulated ; subject to that reservation, however, he would make a short statement at each meeting on the lines indicated.

Mr. Armstrong then said that he accepted this suggestion and withdrew his resolution.

REPEAL OF THE PROVISIONS OF SECTION 26 OF THE IRRIGATION ORDINANCE

Mr. Wilmot A. Perera moved the following resolution :—

> "For the purpose of developing paddy cultivation, this Board recommends that the provisions of section 26 of the Irrigation Ordinance for the payment of remuneration to irrigation headmen by field owners be repealed."

With regard to his resolution, Mr. Wilmot Perera said he felt that most members were unaware of the conditions obtaining in paddy cultivation whereby the field owners had to give a portion of their profits to the Vel Vidanes. He thought that the most effective way of helping the cultivator was to remove what he would describe as a limitation of production, as well as a social injustice of the greatest magnitude. He believed that the practice was the survival of an ancient custom whereby the cultivators remitted, by an offering from their produce, the work they were expected to perform gratuitously for the King. It had no justification under modern conditions, and his own view of Vel Vidanes was that they were a useless body of men. He did not know what functions they performed in the dry zone ; as far as his own district was concerned he was certain that they rendered no service at all to the cultivators, yet they were given one-sixty-fourth of the gross production of the fields.

The Chairman pointed out that this matter was entirely in the hands of the proprietors themselves. Section 7 of the Irrigation Ordinance provided for the election of a committee by proprietors themselves, and section 26 laid down that the committee elected by the field owners might fix the remuneration to be paid to the Vel Vidanes. It was, therefore, entirely in their hands and he did not see how the Board could interfere.

After a few further comments, as no one seconded the resolution, the motion was not proceeded with and the discussion terminated.

THE INAUGURATION OF PADDY SEED DEPOTS THROUGHOUT THE ISLAND

Mr. Wilmot A. Perera proposed the following resolution :—

> "This Board is of the opinion that the Department of Agriculture should explore the possibilities of inaugurating a chain of seed-paddy depots throughout the country for the loaning of planting material without interest charges and carrying a departmental guarantee of purity."

Opening the discussion on this resolution Mr. Perera said it would not be denied that one of the best methods of developing the cultivation of paddy or any other crop was by the utilisation of pure strains. As matters were at present, cultivators were charged, even by the Department of Agriculture, for the seed-paddy that was loaned to them, at 25 per cent. interest; two months ago it was 50 per cent. If a cultivator was provided with a bushel of paddy he had to return a bushel and a quarter, previously it was a bushel and a half. Recently as members might be aware, there had been a shortage of seed-paddy and the Department had had to indent for seed-paddy from India. That showed how unprepared they were for emergencies. He was aware that the Department had established a number of seed farms for pure line paddy, but in his opinion the selection left much to be desired. There were no seedsmen in this country, as was the case in European countries, and until this stage was reached he considered it was the duty of the Department of Agriculture to distribute seed-paddy. During the last acute shortage of seed-paddy some persons with a commercial turn of mind cornered the market and villagers had to buy from them at Rs. 4·00 and Rs. 5·00 a bushel. The question of reducing the rate of interest was discussed in his District Committee, but it was said that this was very difficult. He added that in Denmark, two-thirds of the seed-paddy retained for consumption or for export bore the guarantee of the State. He himself had obtained seed-paddy from the Department for use on demonstration farms, but on the plots on which the guaranteed seed-paddy had been planted the crops had failed. Since these failures the villagers were chary of using seed-paddy distributed by the Department of Agriculture.

Mr. A. C. Attygalle formally seconded the resolution.

Mudaliyar N. Wickremaratne said he considered that Divisional Agricultural Associations should be the medium through which seed-paddy was distributed or else co-operative societies should be established.

Mr. Lucette (Registrar of Co-operative Societies) pointed out that the villager almost always borrowed his paddy when the price was high and paid it back after the harvest when the price was low. He considered that it was desirable to make good seed-paddy available to villagers by co-operative methods, and they were trying to establish a paddy bank near Hambantota. It was essential, in his opinion, that experiments with regard to pure line seed-paddy should not be made at the expense of the villager. If it was to be successful it should be the type of paddy which was popular; it was no use trying to distribute a paddy when there was the complaint that however admirable a strain it might be, it did not come up to expectations.

Mr. G. V. Wickremasekera (Acting Economic Botanist) said that on the instructions of the Director of Agriculture investigations were being made to divide the Island into suitable zones for each season. In respect of each such zone a suitable pedigree selection of paddy of normal growth period would be established, and in addition, an early maturing selection for use in cases when the rains were late or sowing delayed. Wherever suitable pedigree selections

had not already been established, trials would be made of the existing pedigree selections and, where necessary, fresh selections made of the most popular variety in the particular locality. They were already engaged in the work of selection, and paddy-seed farms of about thirty acres in extent, for the multiplication of the suitable pedigree selections in each zone, would be established wherever necessary. Action was thus being taken on the lines desired by Mr. Wilmot Perera. As regards the rate of interest on seed- paddy, the interest now charged was 25 per cent. in kind or 9 per cent. cash per annum. When seed-paddy was issued for sowing it was thoroughly winnowed and the ruling market price was comparatively higher than at the time of harvest. The seed-paddy returned in kind with interest was not thoroughly winnowed and contained a good deal of chaff; thus it would be apparent that the rate of interest was not as exorbitant as at first sight it appeared to be.

The Chairman intimated that he thought it would not be necessary to vote on this resolution. He was in entire sympathy with it and he considered it was the duty of the Department, if not to supply seed-paddy to people on any terms, at least to direct its attention towards establishing suitable varieties in different areas. The action that Mr. Wickremasekera had described had been taken with that end in view. It might take some time ; they would appreciate that the experiments depended upon the life cycle of the plant ; that period usually took four months, and it might take twenty or thirty experiments before one succeeded in evolving a suitable variety. These experiments, therefore, would take some time, and executive action after the experiments, had been made would take some time longer ; but it was hoped in time to establish a series of seed-paddy farms throughout the country to suit the different localities.

With regard to the rest of the resolution, he said he must definitely decline with the organisation he had, and could ever hope to have, to give loans of seed-paddy to all farmers and recover it. The only possibility was, that when they had established the seed farms and had the paddy available for distribution, it would be given either in return for its cost or in exchange for an equal quantity of ordinary paddy. He did not give an undertaking that he would adopt these two courses of action, but he merely mentioned them as the only two practicable alternatives. He was not able to undertake the issue of paddy on loan. As regards the interest charges he thought enough had been said, and he enquired, in view of his observations whether Mr. Perera wished to press the resolution he had moved.

Mr. Wilmot A. Perera indicated that as a result of the remarks made he would accept the assurance he had been given and withdraw his motion, but he would like to stress the great necessity for a departmental guarantee of purity.

THE CONSERVATION AND DISTRIBUTION OF WATER AND FIELD CULTIVATION UNDER MAJOR IRRIGATION WORKS

The following resolution proposed by Mudaliyar S. Muttutamby was then taken up for consideration :—

> " As the present duties of the cultivation officer are concerned with the issue of water from the main channels of a major irrigation work, while the maintenance of the same channels is entrusted to an Irrigation Engineer, it would be a more satisfactory arrangement if the responsibility for the conservation and distribution of water under a major scheme be placed in the hands of a Senior Irrigation Officer, while the supervision and improvements of the cultivation work in the fields be entrusted to a Senior Agricultural Officer."

Before calling on Mudaliyar Muttutamby to move this resolution the Chairman informed the meeting that he had that morning been in telephone communication with the Irrigation Department on this subject. The Director of Irrigation had informed him that the assumption in the first part of the motion was incorrect, as the distribution of water from the main channels of a major irrigation scheme was entirely in the hands of the Irrigation Officers. The distribution of water through the fields by the field channel system was entirely in the hands of the cultivation officers, the Irrigation Department being in charge of the distribution of water in the irrigation channels until the water reached the field channels.

Mudaliyar Muttutamby pressed his point and elaborated the distinction between major and minor channels. He stressed the fact that there was a certain amount of overlapping in the duties of the respective officers.

Mr. Rolf Smerdon said that there appeared to be much overlapping control, which he thought was very prevalent in Ceylon. He seconded the resolution provisionally, subject to the facts being correctly stated.

Mr. S. Armstrong intimated that the matter appeared to be a question of certain channels not being defined or demarcated. He was not clear as to exactly what Mudaliyar Muttutamby intended by his resolution. He pointed out that major, minor and subsidiary channels of a major work came under the Irrigation Department and field channels under the Cultivation Officers ; the latter must have the water under their control for its distribution to the fields. He suggested, therefore, that the proposer should omit the words " and distribution " from the text of his resolution as this formed a part of the work of the cultivation officer.

Mr. Wace de Niese indicated that from the discussion that had taken place there appeared to be some misunderstanding ; it was perhaps hardly a matter which the Board ought to consider.

The Chairman said that the conflict appeared to him to be at what particular point the irrigation channel ended and the field channel began. The real point was not with regard to the control of the major channels but with

the distribution of channels between the Irrigation Department and the Cultivation Officers. He suggested that Mr. C. L. Wickremasinghe might be able to give them some assistance in making this matter more clear.

Mr. C. L. Wickremasinghe said that on the question of overlapping, his experience had been that the Irrigation Department confined their responsibility to major channels which ran through Crown land, whereas the field channels generally ran on private land. Very often the method of delimitation of responsibility was for the Irrigation Department to take upon themselves the responsibility of maintaining all channels on public property or Crown land ; but they did not as a rule, and quite rightly, take upon themselves the distribution of water in the field channels. He added that he had some experience of working in the North-Central Province and, so far as he was aware, the trouble which Mudaliyar Muttutamby claimed to exist in Mannar did not exist in other districts.

After some further discussion the motion was put to the meeting in the following amended form, the Chairman pointing out that it had been seconded with the proviso that the facts were correct and could be passed only subject to that proviso :—

> " As the present duties of the Cultivation Officer are concerned with the issue of water from the main channels of a major irrigation work, while the maintenance of the same channels is entrusted to an Irrigation Engineer, it would be a more satisfactory arrangement if the responsibility for the conservation of water from a major scheme be placed in the hands of a Senior Irrigation Officer, while the supervision and improvement of the cultivation work in the fields be entrusted to a Senior Agricultural Officer."

The resolution was carried unanimously in this amended form.

The meeting terminated at 4·40 p.m., Mr. R. P. Gaddum proposing a hearty vote of thanks to the Chair.

W. C. LESTER-SMITH,
Acting Secretary,
Central Board of Agriculture

REVIEW

All about the Soya Bean—By George Douglas Gray, Pp. viii—140, 7 Plates, London : John Bale and Danielsson, Ltd., 1936, 7s. 6d.

THIS book is a welcome addition to the already voluminous literature on the soya bean. Colonel Gray has had considerable experience of the soya industry in the Far East. Mr. J. L. North, one of the pioneers of soya cultivation in England, contributes a foreword. Colonel Gray's opening chapter introduces the reader to soya bean growing in Manchuria, China and Japan, and ends with a plea for a state subsidy for British-grown soya.

Chapter II is entitled "the soya bean and its cultivation". A brief discussion of nomenclature is followed by a description of the plant and an account of its introduction into Europe and the United States of America. Some of the author's statements on soil inoculation need modification. "In England," he writes, "inoculation seems to make little or no difference to the crop". Soya beans may be grown in England without inoculation, but then the beans are much smaller and lighter, and contain much less protein than those of inoculated plants. Again, he states that "in parts of Central Europe soya beans were grown successfully long before anything was known about inoculation and therefore could not have been infested by bacteria". A suitable strain of the bacterium probably occurred naturally in Central European soils, and artificial inoculation was hence unnecessary. It might be mentioned in this connexion that soya cultivation in Ceylon has been a comparative failure evidently because the right strain of the bacterium does not occur in Ceylon soils. In 1918, eighteen varieties of soya bean were imported from Yokohama by the Ceylon Agricultural Society and tested out in various parts of the island. It was found that the bean grew better at the higher elevations and in the drier climates, *e.g.*, in Bandarawela and Harasbedde. A white seeded variety of soya is at present being grown at the Experiment Station, Peradeniya, without much success.

The present position of the subject of soil inoculation may be stated as follows : On rich soils, soya may be grown without inoculation ; but then there is a drain on the soil nitrogen. On soils poor in nitrogen, inoculation is essential. This inoculation may be by a naturally occurring strain of the bacterium or by an artificially introduced one. The author dismisses the question of methods of inoculating the soil in about half a page. As much space is devoted to a digression on Chateau wines as to the whole technique of soil inoculation.

Chapter III is an extremely well-written account of the soya bean as food. The author explains the elements of dietetics and proceeds to emphasize the value of the bean as a source of cheap protein. The soya bean ought to make headway in a country like Ceylon where a large section of the people would welcome a vegetable substitute for meat. The protein content of the bean is twice that of meat. Other virtues of the bean are discussed, *e.g.*, its almost complete freedom from starch and its consequent use in the diet of diabetics, its possession of vitamins A, B, D and E, and its high phosphorus content.

Chapter IV deals with the industrial uses of soya bean oil, and includes an elaborate and rather irrelevant account of Mr. Henry Ford's " industrialized barn". Chapter V gives a valuable summary of trade statistics. Chapter VI is a discussion of the place of the soya bean in agriculture. The relative freedom of the plant from disease is commented on. The absence of a chapter on the use of soya as a green manure is disappointing. Scattered references to the fertilizing value of the plant however occur throughout the work. The appendix gives a list of American soya preparations, soya recipes, statistics and a bibliography of 19 titles. There are 7 excellent photographic illustrations.

The book is not as encyclopaedic as its title suggests, and is badly balanced. It is nevertheless a valuable book.—M. F.

ANIMAL DISEASE RETURN FOR THE MONTH ENDED JUNE, 1936.

Province, &c.	Disease	No. of Cases up to date since Jan. 1st, 1936	Fresh Cases	Recoveries	Deaths	Balance Ill	No. Shot
Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1615	885	1104	5	506	..
	Anthrax	..	..	..	..	..	..
	Rabies	16	2	..	..	..	16
Colombo Municipality	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1334	33	1311	14	9	..
	Anthrax	..	..	..	..	..	..
	Rabies	26	3	..	26	..	..
Cattle Quarantine Station	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	3	..	3	..	..	..
	Anthrax	21	2	..	21	..	..
Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1393	137	1355	6	32	..
	Anthrax	11	7	..	11	..	..
	Tuberculosis	1	..	..	1	..	..
	Rabies	7	7	..	7	..	..
Southern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
Northern	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	313	58	310	3	..	..
	Anthrax	..	..	..	..	..	..
Eastern	Rinderpest	FREE					
	Foot-and-mouth disease						
	Anthrax						
North-Western	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	1105	375	819	1	285	..
	Anthrax	..	..	..	..	..	..
	Rabies	19	..	..	1	..	18
North-Central	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	661	..	661	..	..	..
	Anthrax	..	..	..	..	..	..
Uva	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	..	..	..	..	..	..
	Anthrax	..	..	..	..	..	..
	Rabies	2	..	..	1	..	1
Sabaragamuwa	Rinderpest	..	..	..	..	..	..
	Foot-and-mouth disease	395	327	69	3	323	..
	Anthrax	..	..	..	..	..	..
	Haemorrhagic Septicaemia	3	..	..	..	3	..
	Rabies	2	..	..	..	..	2

Government Veterinary Department,
Peradeniya, 16th July, 1936.

M. CRAWFORD,
Government Veterinary Surgeon.

METEOROLOGICAL REPORT—JUNE, 1936

Station	Temperature				Humidity		Amount of Cloud	Rainfall		
	Mean Maximum	Difference from Average	Mean Minimum	Difference from Average	Day	Night (from Minimum)		Amount	No. of Rainy Days	Difference from Average
	°	°	°	°	%	%		Ins.		Ins.
Colombo ..	84·8	− 0·3	76·3	− 0·7	75	84	7·2	5·97	21	− 3·01
Puttalam ..	85·9	− 0·1	77·8	− 1·3	77	89	6·1	1·64	13	− 0·03
Mannar ..	87·2	− 1·4	80·2	− 0·3	74	80	6·2	0·07	1	− 0·43
Jaffna ..	85·5	− 0·8	80·1	− 0·5	79	82	5·2	0·	0	− 0·40
Trincomalee ..	92·3	+ 0·8	78·2	− 0·4	56	78	6·8	0·04	2	− 1·04
Batticaloa ..	91·1	− 1·0	76·9	− 0·3	62	82	6·0	0·59	4	− 0·42
Hambantota ..	85·6	− 0·3	76·2	− 0·3	80	91	5·4	0·91	9	− 1·32
Galle ..	83·0	− 0·6	76·9	+ 0·2	78	84	6·0	9·80	19	+ 1·12
Ratnapura ..	87·3	+ 1·0	72·8	− 1·5	74	98	6·1	7·68	18	− 11·36
Anuradhapura ..	88·8	− 0·4	75·6	− 0·6	66	91	7·0	0·78	3	− 0·16
Kurunegala ..	86·0	− 0·5	74·8	− 0·5	74	88	6·0	3·01	14	− 4·38
Kandy ..	84·1	+ 1·0	70·6	− 0·5	72	87	6·0	3·43	16	− 6·15
Badulla ..	84·7	− 0·5	65·0	− 0·4	63	92	4·8	1·01	6	− 0·78
Diyatalawa ..	77·4	− 0·4	62·2	− 0·8	66	81	5·2	0·88	6	− 0·89
Hakgala ..	70·4	+ 0·9	58·2	+ 0·1	76	81	6·5	3·69	17	− 3·29
Nuwara Eliya ..	67·2	+ 0·9	54·3	− 1·2	81	88	7·9	5·88	22	− 5·06

The rainfall for June was nearly everywhere below normal. Excess was mainly reported from stations along the west coast between Chilaw and Mannar, and along the east and south-east coasts between Batticaloa and Hambantota, but this excess was only small. Deficits were most marked on the lower south-western slopes of the hills, where the rainfall is usually heaviest this month, and in the low-country adjoining. The greatest deficits below normal were 22·04 inches, at Carney, and 20·29 inches, at Watawala, while deficits between 15 and 20 inches were also reported from Maliboda, Ingoya, St. Andrews, and Blackwater. The highest monthly totals were 26·04 inches, at Kenilworth, and 20·41 inches, at Watawala, while falls of 15 to 20 inches were reported from Blackwater, Padupola, Kitulgala, Kellie, Ingoya, Dabar, Norton Bridge, and Kokkawita. North of the Mannar-Trincomalee line, very few stations reported any rain at all during June.

Only one daily fall of over 5 inches was recorded, 5·54 inches, at Kokkawita, on the 4th.

The barometric gradient and the wind were consistently monsoonal during the month, while the rain was mainly confined to the south-west of Ceylon. During the first four days of the month it continued to be widespread in these districts, but was not particularly heavy. It then eased off, and not much rain was reported till the 11th. Between that day and the 15th the rain was widespread in the south-west, and fairly heavy in places. It then decreased, but increased again from the 20th, while fairly heavy widespread rain was reported in the south-west of Ceylon on the last two days of the month.

Temperatures were, on the whole, a little below normal, particularly at night. Cloud was generally a little above normal in the north-east and east, and appreciably below normal elsewhere, while humidity in general showed no marked deviation from average. Barometric pressure was above normal, while the gradient was about the average. Wind was a little below normal strength in the south and west, and above normal in the north and east. Its direction was mainly south-westerly or westerly.

A hailstorm was reported, both from Hakgala and Blackpool, near Nuwara Eliya, on the 7th.

H. JAMESON,
Superintendent, Observatory.